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ARCHIVES OF OPHTHALMOLOGY.

CORRECTION OF SQUINT BY MUSCLE RECESSION WITH SCLERAL SUTURING.

BY DR. P. CHALMERS JAMESON, BROOKLYN, N. Y.

(With four illustrations in the text.)

SIMPLE tenotomy was the earliest operation performed for squint. Deffendorf divided the belly of the muscle, the muscle retracted, did not unite with the sclera, paralysis followed, and the operation fell into disrepute. Bohn introduced the method of to-day, and Von Graffe, Knapp, and others followed with suggestions as to securing and regulating the effect. Even with these guides to regulate it has always been an uncertain operation, sometimes giving brilliant results, holding and maintaining them, and again proving a disappointment, giving way, retracting the caruncle, and wholly or partially paralyzing the muscle. Its uncertainty is attributable to one very unreliable factor, namely, the question of muscle union or fixation with the sclera.

If the muscle should happen to form its reattachment to the sclera at the point desired of course it is successful. If it should curl up, make a conjunctival attachment, retract within its sheath, drop behind the contact arc, it may be a partial, or complete and disastrous failure. These conditions while not as applicable to the partial or guarded tenotomies as

[1] Read before the American Ophthalmological Society, Washington, D. C., May 1, 1922.

practiced to-day, cannot be altogether eliminated and the danger is in ratio to the extent of the partial tenotomy done and to the attenuation of the muscle produced.

It was with these facts in mind coupled with the thought that a muscle could and should be receded with the same exactness and precision that it could be advanced, that the writer was prompted to seek the means, and also endeavor to find the limits of its utility.

To find this it was necessary to demonstrate the stabiliment of the scleral tissue behind the muscle insertion as a suitable and practicable suturing medium, and to devise a technique by which the operation could be easily and satisfactorily performed.

Scleral suturing had been practiced as a successful procedure in front of the muscle where the episcleral tissue is dense and abundant. It has not however been utilized to any great extent behind the insertion of the muscle.

Since writing this paper I have received a reprint of an operation by Dr. Curdy of Kansas City describing a one suture recession operation, with scleral suturing to the superficial sclera. This he does coincident with a similar advancement on the opposing side. It appeals to one as an ingenious and practical operation.

Beard states that Prince of Springfield practiced a recession operation with what he called "tenotomy with control suture." Colburn, in 1889, practiced a similar tenotomy with "restrain suture" and he himself practised an operation under the caption of curb tenotomy. He did not practice scleral suturing but sutured to Tenon's capsule.

The following paper is a study of 56 operations of recession without advancement in which deep scleral suturing short of perforation is practiced.

The operation about to be described freely exposes the muscle and after detaching it, separates it from the globe, as also its capsular continuity above and below, leaving however its sheath intact.

It transplants it at once to a position placed further back and permits the operator to accurately grade the operation, and by scleral suturing, gives him a definite understanding of the location of reattachment. It also establishes a safeguard

against future retraction, and it introduces and elaborates a technique for safe scleral suturing.

Every new operation is an interrogation point, and in this vein I venture to present the operation, feeling justified by the results obtained in this preliminary study.

The operations have all been performed upon cases of internal concomitant squint with two exceptions.

The following are the steps of the operation.

A conjunctival incision is made about seven millimeters long following the curve of the semi-lunar fold, the center cor-

FIG. 1.—Muscle exposed. Capsular incisions pass backward beyond equator.

responding to the caruncle. The ends of this incision are prolonged toward the cornea and in the direction of the fornici above and below. The flap is undermined to its base and turned over toward the cornea. The semi-lunar conjunctiva is also undermined in the direction of the caruncle, with care not to disturb the fascial trebeculæ or areolar tissue on the surface of the muscle.

The muscle is now undermined, completely separated from the globe, and its capsular continuity severed above and below by incisions carried back beyond the equator. A tenotomy hook is inserted to facilitate clean dissection, and Reese forceps, placed behind it, grasp the muscle. The hook is withdrawn and the muscle severed from its insertion in the usual way.

It is an advantage to have the operative field completely

exposed and ample room to manipulate the needle. The sclera now exposed should be sponged and cleaned of blood particles and the outlying muscle fibers, if any, freely severed.

The distance from the muscle insertion which the operator desires to recede the muscle end is now measured in millimeters and the point noted on the sclera. The remaining steps in the operation are very simple.

Three single armed sutures are provided. The first, the central one, is introduced from without the conjunctival lip

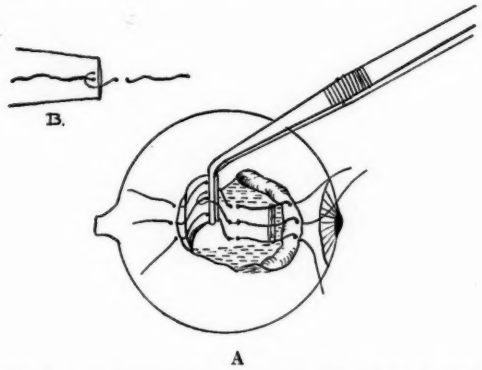

FIG. 2.—A. Muscle ready for recession. Three sutures introduced through conjunctiva, muscle, sclera, and again through conjunctiva. B. Detail of central suture.

nearest the caruncle, then perforates the outer surface of the muscle end, just below the center behind the forceps. At this point to make for the utmost safety in the bite of the suture, the needle is put through the muscle from the under side above its first perforation (that is just above the center of the muscle) and is brought out on the upper side of the muscle, the thread being looped around the thread of the first perforation. This simple suture is easily seen on the diagram. The sutures are now continued right on through the sclera and out and finally through the lip of the conjunctiva nearest the cornea. The two remaining sutures, about three millimeters above and below the center, are carried directly through the conjunctiva lip, muscle end, sclera, and conjunctival lip nearest the cornea.

The sutures are now carefully separated, the blood debris cleared away, the muscle approximated to its new scleral attachment.

The tying of the sutures firmly holds the muscle to its new scleral position and at the same time closes the conjunctival

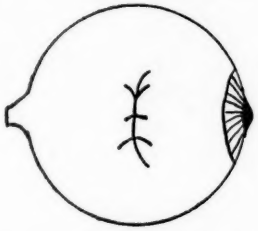

FIG. 3.—By tying the sutures the conjunctival wound is closed and the muscle, at the same time, is brought to its new point of attachment.

opening. The central suture resolves itself into a surgical knot and tightly holds a bundle of muscle fibers in firm apposition to the sclera. If the conjunctival wound gaps between the sutures, it is wise to supplement surface conjunctival sutures.

It will be found an advantage after the sutures are tied to leave the ends long enough to be loosely held out of the way by an adhesive strip to the bridge of the nose. It greatly facilitates their removal to be able to abduct the eye by traction through them. The knots can then be pulled into view. They can be removed on the sixth or the seventh day.

Certain precautions should be observed in order to make a smooth and facile operation. The conjunctiva should be carefully separated leaving the supra-muscular tissues intact. The areolar tissue in which the muscle is deeply imbedded in the region of the caruncle should not be sliced. If this is done the muscle is endangered, the anatomy disarranged, and the reaction will be greater.

It is of great advantage to leave the mass of fat and fascia in which the muscle is embedded posteriorly intact. It not only preserves the anatomical relationship of the parts but leaves a compact mass of tissue in continuity with the capsular incisions above and below which unites and adds to the strength of the scleral attachment.

The needles should be small, 10 millimeters from tip to eye, full curved and sharp. A large blunt needle would endanger the operation. The thread should be No. 1 or 2 twisted silk.

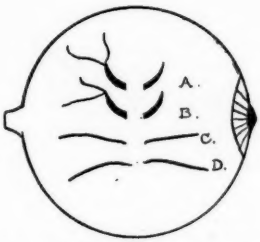

FIG. 4. Illustration of scleral suturing. A. Needle perforating the sclera. B. Non-perforating needle. C. Suture of perforation. D. Suture of non-perforation.

The stabiliment of the sclera, the first thing to be questioned in connection with the operation, is a most clearly demonstrable fact. The sclera, formed, as it is, of white fibrous and yellow elastic fibers in bundles having an equatorial direction and also lying in meridian lines, makes the best structure for engaging of a needle.

The strength of these fibers is remarkable as the following experiment showed. A freshly enucleated eye was sutured with No. 1 twisted silk and the thread was looped. . The globe was then opened to make assurance the needle had not perforated, which was found to be the case.

The excised section was firmly held between the hook forceps and articles of various weight were added one by one to the loop. They weighed one pound and one half ounce and the sclera still held. Three sutures will hold three pounds one and one half ounce without tearing out, and probably more.

The technique of introducing scleral sutures in order to obtain the deepest bite without perforation is important. The sclera is less than one millimeter thick in and around the equator and may be easily perforated. A thick large needle may burst the fibers, a sharp small slender needle will split the bundle layers with facility if handled as follows:

The needle engages carefully at first and the point, which should always be watched and visible, picks up a bundle of

fibers and as the point of the needle becomes indistinct it is made to approach the surface but not to pass through the surface, steady pressure being exerted as it makes its way through the tissue and engages in its bend substantial bundles of fibers. The motion employed is such as one would use in picking up the fibers of a thick linen handkerchief bent over the finger without pricking the finger.

The bend of the needle after counter puncture should be seen in its entire continuity through the translucent sclera as also the suture after it has been drawn. Such a suture has not perforated.

Performed after this manner scleral sutures will hold and can be manipulated with the greatest confidence and equanimity. With a perforating suture, neither the needle bend or thread can be seen as they pass through the sclera.

If the operator should strike a small vein the non-resistance is at once detected, the point withdrawn and introduced one millimeter in any direction. The two dangers, unsuitable anchorage and perforation, commonly cited as precluding scleral suturing in this region are found to be groundless and erroneous. The above technique opens a field of wide practicability for scleral suturing in muscle operations.

The reaction and trauma is moderate if the operation has been performed smoothly. In a former operation the sutures were tied over rubber banding and the local reaction was considerable. The simple operation just outlined makes the reaction negligible and local. In none of the cases has there been any deep reaction. In no case has there been general conjunctival chemosis. None of the cases showed interior involvement of the globe. Post-operative granulations are easily removed.

Retraction of the Caruncle.—There has been but slight retraction of the caruncle and that difficult to distinguish and of negligible quantity. The writer is conversant with the painstaking work and investigation by Dr. Howe and others on caruncular retraction. As the result of these observations on operations so near this structure he would add this contributive suggestion, that the muscle firmly attached to the sclera at or in front of the equator, is the beam that holds these tissues in normal anatomical relationship. If this, the muscle

attachment, gives way, all surrounding tissues are dragged backward and with them follows retraction and slight inversion of the caruncle.

The Determination of the Amount of Recession.—Taking the equator as the possible limit to which a muscle should be receded the average distance between the insertion of the internal rectus and the equator is not probably more than five and at most six millimeters, the measurement depending on the diameter of the cornea, the distance between the insertion of the muscle and the limbus, and the age of the patient. These, therefore, should be measured and the computation reckoned before the recession is made.

The indications as to the amount of recession conform to those in general usage together with certain observations gained from the operations done. Among these is the degree of squint, fixed, alternating, or periodic. A greater degree of recession is necessitated if the squint is fixed. Marked correction of squint with glasses should lessen the recession. Then there is the excursive power of the opposing muscle. Divergence insufficiency would increase the amount of recession to be done. The age, duration of squint, and the visual acuteness of the deviating eye are all to be taken into consideration.

The length, size, breadth, and the laxity or tension of the muscles are important factors in estimating the amount of recession. Frequently a short, tense, powerful muscle is to be found on the non-deviating eye, equal in size to that of the deviating eye.

The rule of one millimeter to each five degrees of deviation has not been strictly adhered to. Certain broad limitations have been found practicable having for their object the protection of convergence with the greatest amount of correction.

In operating upon the strong muscle we have generally found it a safe procedure to recede to the five millimeter limit if the deviation is over twenty-five degrees and if scleral fixation is practiced. In doing a double recession we have found safety in receding to four millimeters on both sides if the deviation is over forty degrees and if scleral suturing is practiced. Modifications from these extreme limitations, the operator applies to individual needs.

Certain factors, however, which come under the heading of post-operative adjustments cannot be wholly estimated before operation. Principal among these are—first, the post-operative neuro-muscular element; second, the indefinite knowledge before operation as to the adductive contributions of the supplementary adductor muscles; third, what Jackson termed the connective tissue influences. They, the post-operative neurological, muscular, and connective tissue obstructions, are contributory causes of failures or partial failures in well regulated operations and contribute an erratic quality to final results.

They are the post-operative obstacles which muscles newly placed have to contend with. Whitnall states, "that in a firm body such as the eyeball revolving against a cushion of fatty tissues the fat will be pressed away and the connective tissue meshwork supporting it condensed with a membrane-like surface."

It is reasonable that an eye deflected laterally for a number of years must have shaped a socket for itself differing from the normal and that connective tissue contractors and atrophies, adapted to the new position of the globe, take place.

But a knowledge of the extent of these contractures can sometimes be acquired at the time of the operation. If the stump of the muscle after detachment is grasped and the eye forcibly rotated outward impediment to free excursion is often noticed, and the operator can take advantage of this fact to incise the capsule equatorially above and below.

That connective obstructions are not the all-important factors that newly placed muscles have to function against, and that neuro-muscular conditions play an important rôle, is proved by the fact that the weak abductive muscle, as a rule, experiences no difficulty in rotating the eye freely to the outer canthus, as also by the truth that in double recession the operation on the non-deviating eye frequently contributes a large amount of correction. That the muscle of the opposing non-deviating eye is often of as large a caliber, short and tense, as that of the deviating eye is undoubtedly one of the reasons for this contribution, and a very potent argument for a double-sided operation.

Results of Operations.—There have been thirty-nine patients upon whom fifty-six operations have been performed—twenty-two of these upon whom single recession was done and seventeen upon whom double recession was performed. The early operations were all single recessions. In the later operations the effect was divided between both eyes.

The total number of degrees of squint of the twenty-two cases of single recession was 655 degrees. The uncorrected residue two weeks after the operation was 117 degrees. Of these twenty-two single recessions five were under 25 degrees and all were corrected. The remaining seventeen, therefore, left an average of 6.9 degrees. Ten of these single recessions were over 30 degrees: five were 40 degrees or over. They of course were beyond the corrective possibility of a single recession operation.

These results point to the limit of a single recession of five millimeters with scleral fixation as being 25 degrees, or, at most, under unusual post-operative, non-obstructive conditions 28 degrees. Beyond this an interfacial or aponeurotic attachment is likely to exist.

The total number of degrees of squint in the seventeen cases upon which the double recessions were performed was 636 degrees. The uncorrected degree of squint after operation was 64 degrees, an average of 3.8 degrees for each case. Fifteen of these seventeen cases of double recession were over 30 degrees, nine were 40 degrees or over. Fourteen of these seventeen cases were corrected within 5 degrees.

None of these 56 cases have diverged perceptibly for distance. A few of the amblyopics have faltered in convergence before the five centimeter point was reached but within two weeks after operation have improved as the wounded muscle recuperated. Moreover, it is an interesting fact that faltering convergence may be expected immediately after the recession operation but that convergence is regained when the wounded muscle is healed. With the exception of four cases which faltered at 3 millimeters they have adducted to the caruncle.

These operations were performed on cases kindly turned over to me by my associates at the Brooklyn Eye and Ear Hospital together with those of my own clinic and private

practice. They, my associates, have in most cases witnessed the results.

Through the courtesy of Dr. Wheeler I operated upon two cases at the New York Eye and Ear Hospital. One was a squint of 30 degrees, the other of 35 to 40 degrees. A double recession was performed on the thirty-five degree squint at two sittings which resulted in correction and preservation of convergence. The second case upon which a single recession was performed left a residue of 15 degrees, and has not yet been operated upon again.

Also through the kindly invitation of Dr. Knapp two operations were done at the Knapp Memorial Hospital. On a deviation of 45 degrees a double recession was performed. This case perceptibly diverged during the first week. Three weeks after he had a slight convergence of about 5 degrees. On the second case, a 50 degree squint, a single recession was performed. It corrected 27 degrees of the deviation, and abduction, which faltered at 5 millimeters from the canthus before the operation, was also corrected. This case was advanced later as the patient desired that one eye alone be operated upon.

Of the lesser degrees of deviation one of only five degrees, the residue of an operation performed many years previous, was receded three millimeters. Ten days after operation he had twelve degrees exophoria, three weeks after operation, seven degrees exophoria with correction of the aforesaid deviation.

SUMMARY OF USEFULNESS OF OPERATION.

1st. It primarily attacks the offending muscle and puts the greatest emphasis where the seat of the deformity begins.

2d. It leaves an unmutilated muscle system with a broad properly placed attachment capable of normal action and vigorous work.

3d. It enlarges the effect of tenotomy by boldly carrying the muscle end back to the equator if necessary. The exposition of the field enables the operator to make valuable observations relative to the length, breadth, laxity, tension, and connective tissue obstructions. It enables him to grade his

operation accurately, insures a non-pointed attachment, and leaves him with a definite understanding as to where his muscle is fixed, and renders tenotomy by reason of scleral fixation a safe and reliable procedure.

4th. It safeguards convergence to a striking degree. This has been the most gratifying outcome of the operations performed, and is attributable to the fact that a powerful muscle properly and broadly attached to the sclera, working from its primary origin at the optic foramen, and from its secondary action or origin from the diversion of the check ligament, and supplemented by accessory adductor muscles, is a bulwark for the preservation of convergence.

5th. Its corrective capabilities are extensive and comparatively uniform.

A single recession of five millimeters with scleral fixation will correct a deviation of 25 degrees in a high percentage of cases.

A double recession of four millimeters on both sides with scleral fixation will correct deviation of 35 degrees or above in a high percentage of cases.

Finally, the operation of recession with scleral suturing has all the traditions for good which tenotomy has accomplished in the past and provides that very important feature which it lacked, namely, definite scleral fixation.

ILLUSTRATING DR. ELLIOT'S ARTICLE ON "THE FILTERING SCAR."

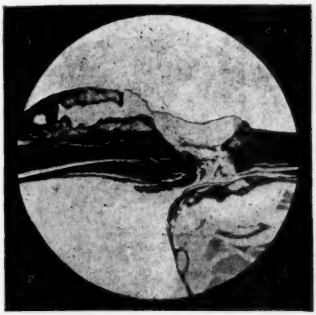

Photo by E. E.

FIG. 1.—A meridional section through the fistula and the filtering scar. The ciliary body is entangled in its depths; it will be observed in Fig. 1 that the surgeon who performed the operation trephined rather far out, and so lost some of the advantage gained by the splitting of the cornea. The fistulous passage is in free communication with a widely open subconjunctival filtering space. The tissue in both cases is made up of extremely loose connective tissue, very poor in cells, and enclosing a large number of open spaces, which are nowhere lined by endothelium.

Photo by E. E.

FIG. 2.—The scleral fistula on a larger scale (from Fig. 1). To the left upper corner of the figure is the communication between the fistula and the subconjunctival filtering scar.

Photo by E. E.

FIG. 3.—The scleral wall of the fistula shown in Fig. 1. The membrane of Descemet can be clearly seen sharply cut across on the edge of the fistula. On tracing it to the left, hyaline excrescences are seen on its surface; farther still to the left, it breaks up to form the pectinate ligament.

Photo by E. E.

FIG. 4.—The right hand wall of the fistula shown in Fig. 1. Notice the thinning of the surface epithelium over the filtering scar, and the membrane of Descemet cut off short in the depth of the wound. *M*, Cut end of Descemet's membrane.

ILLUSTRATING DR. ELLIOT'S ARTICLE ON "THE FILTERING SCAR."

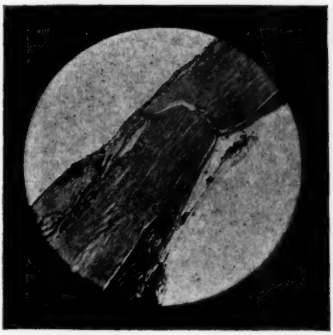

Photo by E. E.

FIG. 5.—A scleral fistula, the result of the couching of a lens for cataract; the ciliary body is impacted in its deepest part, and there is a spongy scar on its conjunctival surface.

Photo by E. E.

FIG. 6.—The conjunctival spongy scar of the previous figure highly magnified to show the open spaces.

Photo by E. E.

FIG. 7.—A trephined disk covered throughout by Descemet's membrane which has become detached from its base owing to shrinking during the preparation and to the act of cutting. Notice on its deep surface to the left-hand side of the figure (the scleral end) the wart-like excrescences due to deposits of hyaline material. Beneath the membrane of Descemet is seen the knuckle of iris which was cut off by the same snip of scissors that divided the hinge of the disk.

Photo by E. E.

FIG. 8.—A trephined disk on the deep surface of which some layers are seen folded back at right angles. These consist of a few of the deep lamellæ of the cornea, and below this again of Descemet's membrane, with hyaline thickenings on its posterior surface. This membrane can be seen to break up into the pectinate ligament which lies to the left. Deep to this again, on the extreme left of the specimen, is a small portion of the knuckle of iris, which was removed at the same time as the disk.

(From Trans. O. S. of U. K., 1918, vol. xxxviii.

THE FILTERING SCAR.[1]

By Lt.-Col. R. H. ELLIOT, London, England.

(With eight illustrations on Text-Plates XVII. and XVIII.)

THE importance of clear conceptions on the subject of the rôle of the filtering scar in glaucoma surgery is paramount, and yet, after all these years of work there is still the widest variation between the views held by men of large experience. Some of these ideas, I hold to be most misleading, and I therefore desire to bring the subject before you once again, in the hope of clearing the ground, and helping to establish a firm foundation for our future building. I have from the first held very definite ideas as to the nature of the ideal filtering scar, which is the end and aim of the glaucoma surgeon. Time has only served to strengthen my beliefs, and the present paper is an effort to point out what to my mind is the real position of the subject.

Von Graefe, as a result of his experience with iridectomy, had dimly appreciated the possible rôle of the filtering scar. De Wecker saw its great possibilities with a clearness of vision that must ever be accounted to him for genius, but it was left to his distinguished countryman Lagrange to turn his dream into actuality by presenting surgery with the epoch-making idea of a deliberate sclerectomy.

The fluctuations in the tidal advance of science are too well known to need comment, but to me it has always seemed little short of lamentable that the surgeon of the 20th century has been so slow to grasp the importance of the great truth which the work of these three men has presented us with. You may

[1] Read before the Section on Ophthalmology of the New York Academy of Medicine, April 1, 1922.

argue endlessly in academic discussion as to the source and method of excretion of the intraocular fluid but, whilst you are doing so, the practical clinician with his patient's sight dependent upon him, will brush aside your weighty and interesting arguments under the burning stress of a need to establish an outflow channel for the aqueous fluid. It matters not to him where the excess comes from. He knows that the eye is hard by reason of that excess, and that the optic nerve and all the other important structures of the globe are steadily perishing under the influence of this increase in the intraocular pressure. He knows too that if he can establish a permanent vicarious channel of escape for the excess fluid, the damage that is being done will be brought to a stop and the sight will be saved. We, many of us, differ on details but the great mass of us unhesitatingly accept these as the daily facts of our struggle with glaucoma.

I hold still, as I have long held, that a very large element in the success of iridectomy has lain in the fact, so long ago pointed out by von Graefe, that a large proportion of the successes attributed to this operation should go down to the credit of the accidental establishment of a filtering scar so frequently obtained as a result of this procedure. This opens up too big a subject for me to discuss here, but one thing, at least I think, you will all concede me, viz., that in a very large percentage of glaucoma cases, the failure to obtain a filtering scar means the failure to relieve the patient.

What is the ideal filtering scar? The answer we decide to give to this question is most important. On its correctness depends our hope of future progress; this is no mere academic subject; on the contrary, it is an intensely practical one. With such considerations before me, I shall endeavor to answer the question at some length, trusting you to realize that the paramount importance of the correctness of our conceptions justifies the course I am taking.

The ideal filtering scar must be (1) permanent, (2) efficient, and (3) safe. We must not forget that the filtering scar is divided into two parts, (1) the fistulous track, through the sclero-corneal tunic, and (2) the overlying pad of conjunctiva and subconjunctival tissue.

(1) *The Permanency of the Fistula.* This depends on a num-

ber of elements. (A) *The Asepticity of the Parts Concerned in the Operation.* We have long known that aseptic wounds in the iris when bathed continuously in the aqueous fluid, show no tendency to tissue proliferation. It is quite clear that the same applies to the other structures of the eye, and that a clean-cut aseptic wound of the sclera or cornea remains indefinitely in the same state as it is left in by the operation.

(B) *The Manner in which the Fistula has been Made.* The less the trauma inflicted, the less is the likelihood of proliferation of the sides of the canal; it is obvious that any such proliferation will tend to block the patency of the fistulous track. Holth has recently shown reason for the suspicion that one of the means by which a trephine or other wound may close up, is the filling up of the canal by such a tissue proliferation from its edges.

(C) *The Absence of Impaction of Uveal Tissue in the Depth of the Fistula.* I have always looked on this as by far the most important factor in the whose case, and I hold as strongly as ever that the glaucoma surgeon's great desideratum is an iris-free scar. To the attainment of this end his every effort should be bent; success in this detail is the surest guarantee of permanent filtration. It is true that there are many points to be taken into account, but this dwarfs all others. Later on we shall have occasion to speak shortly of those procedures in which iris is deliberately included in the operation wound with a view to establishing a filtering scar. For the present we shall confine ourselves to the consideration of the accidental inclusions:

a. Whatever may be the experience of surgeons who perform other operations, those who use the trephine know well that there can be no better augury of success than the absence from the trephine hole of any evidence of the impaction or even of the introduction of uveal tissue. This is a clinical fact which admits of no dispute.

b. Quite a considerable amount of anatomical evidence has been forthcoming of recent years to show that excellent and satisfactory filtration can be obtained in the absence of uveal impaction. We owe to Professor Holth a large part of the work on this subject to which Lagrange, Verhoeff, and others have also contributed. Holth was originally of the opinion

that the establishment of a filtering scar depended on the lining of the walls of the sclerectomy wound with uveal pigment. The photographs in his most recent paper do not appear to bear out such a contention but fall into line with the anatomical findings of Verhoeff and with my own. If I read him aright Holth has evidently taken this view in the light of his more recent and very valuable work. You are doubtless familiar with Verhoeff's excellently recorded case, and also with the one which I have published (Figs. 1 to 4). I would like to direct your attention also to the section of an eye which I had the opportunity of examining, and in which a permanent scleral fistula was present following the couching of a cataract (Figs. 5 and 6). You will observe that though there is some accidental impaction of uveal tissue in the depth of the wound, the main part of the fistula's track is quite clear of it.

It is necessary to turn aside for one brief moment to point out that in glaucoma, as in cataract operations, there is an important difference between a clinically iris-free scar and the same condition anatomically. The latter must be very rarely, if ever, met with, whilst the former can be attained very frequently by the adoption of a correct technique. No one looking at Figs. 1 and 6 can pretend that the fistulæ are lined throughout by uveal tissue, which, if the maintenance of fistulization were dependent on the uveal lining, we should expect they would be. It is obvious in both these cases that such uveal impaction as existed was accidental, and that it was certainly not favorable to the maintenance of free fistulization. Verhoeff's sections are even more convincing on this point.

c. The examination of a number of eyes, in which the trephine hole had become blocked by the proliferation of connective tissue, has shown the presence of pigmentary material in a large number of the wounds, thus suggesting a cause and effect relationship between the entanglement of the uveal tissue and the subsequent blockage of the wound. It is not surprising that there is much more evidence on this side than there is on that which we have just been discussing, for successfully operated eyes seldom reach the pathologist, whilst the failures do so as a matter of routine. May I urge on every one of you the importance of obtaining successful filtering

scars for section whenever possible after the death of a patient. I have not the slightest hesitation in prophesying that the more of such material we accumulate the more firmly we shall establish the important principle of the value of the iris-free filtering scar.

(D) *The Nature of the Operation Performed.* Whilst it is beyond dispute that operations such as sclerotomy and iridectomy may, and not very frequently do, result in the establishment of permanent filtration it will unhesitatingly be accepted by most of us that the rational procedure is to undertake a carefully planned sclerectomy. At the same time we are bound to ask ourselves why it is that these other operations are sometimes successful. Collins has pointed out—and from the clinical point of view I wholeheartedly agree with him—that it is important to include in a keratic-sclerectomy the whole thickness of the tunic of the eye, inclusive of its deepest layer, the membranes of Descemet. Incidentally I may mention that I have demonstrated anatomically that in trephining the membrane of Descemet and the adjacent part of the pectinate ligament can be completely removed over the whole area covered by the blade of the trephine. (Figs. 7 and 8.) How is it then that a mere incision of the parts concerned may undoubtedly result in well-marked fistulization? In attempting to answer this we remind ourselves of the absence of proliferation in aseptic iris wounds, and of Fuchs' observation that even a transfixion of an *iris bombe* may result in the formation of a permanent fistula through the iris. The suggestion that obtrudes itself is that, given any measure of tension on the parts sufficient to convert the incision from a potential slit into an actual passage which can be bathed in aqueous fluid, the tendency to direct healing is in abeyance, and the wound remains a fistula. If we could rely upon this being always the case, the problem of the glaucoma operation would be a simple one. Unfortunately we cannot, and we must therefore plan for the definite removal of a certain thickness of the whole of the ocular tunic, inclusive of the membrane of Descemet. Hence the present position of the Lagrange operation, the Holth's operation, and my own.

One point more before we leave the technique of the operation: A grave menace to permanent fistulization lies in the

plugging of the wound by the downgrowth of corneal or conjunctival epithelium. It is therefore essential to use large flaps in order to remove the external wound as far as possible from the neighborhood of the fistula. It is also important to avoid button-holing of the flap. You will doubtless remember that I have from the first advocated the employment of large flap, and that a number of other surgeons have, of recent years, adopted the same technique, performing their own operation under what they have been kind enough to speak of as "the Elliot flap."

(E) *The State of Health of the Patient.* A sclerectomy, be its nature what it may, may have been most skillfully and aseptically performed with the result that convalescence appears to have run absolutely unimpeded, and yet the fistula may close up; there may be no visible evidence of inflammation, but filtration gradually ceases, and the opening through the sclero-corneal tunic steadily becomes less and less obvious, its place being taken by an opaque thickening of the parts. I think that we must blame this complication to an auto-intoxication, the result of some focus—syphilitic, tuberculous, inflammatory, or of some other nature—which has been overlooked. The clinical importance of the observation is very great, for if we wish to avoid renewed failure, after a second operation, our only course is to submit the patient to a thorough examination for the cause of the trouble and if this is found, to treat it effectively and thoroughly.

We may pause here for one moment to summarize what has already been written, doing so from a slightly different angle: The fistula may become blocked in a variety of ways: (1) This may occur owing to a fault in our asepticity, which may affect the conjunctival and subconjunctival tissue, causing them to mat over and block the outer orifice of the canal; or it may affect the walls of the canal itself leading to tissue proliferation and so to closure of the channel; or it may start in the uveal tissue in the depth of the wound. An unhealthy systematic condition of the patient may lead to the same results. (2) The block may be due to a mechanical plugging of the deep end of the canal by uveal tissue. (3) The channel which has been made may close up by the union of its adjacent surfaces especially in its deepest part. (4) Given defective

operative conditions, the fistula may be closed by the down-growth of epithelium from the surface of the wound.

(2) *The Efficiency of the Filtering Scar.* It is obvious that no filtering scar can remain efficient unless the fistula which feeds it is a permanent one. For this reason each one of the factors which have been discussed under the previous heading has a strong bearing on the efficiency of the filtering scar. When, however, we ordinarily speak of efficiency in this connection, we have a somewhat different idea in the forefront in our minds, the underlying basis of which is that we ought to graduate the fistulous channel which feeds the overlying conjunctival pad in such a way as to ensure a sufficient escape of fluid, and no more, from the interior of the eye to the exterior. If the escape of fluid is too free we get hypotonus, if it is too scanty we get a recurrence of hypertonus. Once again, if we fistulize an eye which is in a condition of simple chronic glaucoma, and if we operate aseptically, we can rely with considerable confidence on the fistula remaining indefinitely of undiminished caliber. On the other hand, if the glaucoma is of chronic congestive or of a subacute or acute variety, we have not quite the same confidence, and we are therefore disposed to make our fistula larger than we otherwise should, with a view to making allowance for a certain and maybe a very appreciable diminution of its powers as an aqueduct. On the strength of such ideas as these the advocates of the leading sclerectomy operations have laid down modifications of their technique to meet the needs of various cases.

The trouble is that the problem is nothing like so simple as it might at first sight appear to be. Take trephining for example as an instance of an operative procedure in which the amount of sclero-corneal tunic removed can be very accurately gauged. We do not find that even in apparently the same class of case the removal of the same amount of a *2mm* disk can be relied on to bring about the same amount of fall in ocular pressure. In one case the operation is followed by considerable hypotonus; in another by a pressure which is little different from the normal, and in a third by a distinct hypertonus, which, however, yields readily to massage. Again, the tendency of all trephined eyes is to show more marked hypotonus in the early stages than at a later period; in other

words the pressure tends to rise somewhat as the condition following the wound settles down. This is not surprising, for the large flap raised at the time of operation must be very loosely attached to the sclera at first, and must gradually re-acquire fresh attachments to it as the wound heals. If you will use a corneal microscope and a Gullstrand slit-lamp, you will see the development of these adhesions in progress, to some extent at least. Even without such aids, the employment of a good loupe will show you the progressive settling down of the scar and the diminution at the same time of the clearness with which the sclero-corneal opening can be seen.

There seems to me to be another factor in these cases, and one which I venture to think is intimately connected with the relative rates of secretion and excretion of the intraocular fluid. I am led to make this suggestion as a result of the observation of a number of cases in which, whilst the anatomic conditions of the fistula have not appeared to alter materially, the eye has passed from a state of marked hypotonus to one either normal or but little below the normal in tension. There can be but little doubt that a compensatory mechanism is at work in the interests of the eye and on the side of the surgeon. It seems not unlikely that the intraocular blood pressure, the vasomotor control of the eye, and the activity of secretion of the ocular fluid may one and all play a part in the process.

Devices to Increase the Efficiency of the Filtering Scar. A certain number of surgeons, dissatisfied with the filtering area they have obtained by trephining, or other means, have suggested the use of silk threads or of metal drains to be inserted under the flap in the neighborhood of the opening of the fistula or actually into the orifice of the latter. Their object seems to be a two-fold one (1) to keep the fistula open and (2) to spread the drainage of the escaping fluid evenly under the flap. In my opinion such ideas are founded on a misconception of the elementary facts that concern the drainage of the eye. To me they seem to be wrong in theory and mischievous in practice: Any surgeon with a wide knowledge of drainage operations must have learned that the essentials of successful fistulization are (1) to provide a wide conjunctival flap, (2) to make that flap as thick as possible, (3) to remove a portion of the whole thickness of the sclero-corneal tunic, (4) to prevent

plugging by the uveal membrane and (5) to ensure asepsis throughout. If these conditions can be fulfilled, satisfactory filtration can be relied on in every case. Failures are due to our inability invariably to satisfy these conditions. As the wide thick flap settles down into its place the best form of filtration follows automatically. Neither threads nor metal drains are needed to direct it. Nor can I conceive how the placing of the end of a silk suture, or of the bent toe of a metal drain into the fistula can be expected to keep it open. I can easily imagine that such devices might lead to fibrous tissue formations and so tend to close the fistula, even if it is itself aseptic. I can also readily conceive one of these drains as being a source of subdued sepsis and indeed we have reason to believe that such they have sometimes proved. I would most strongly urge you by whatever method you choose to do your sclerectomy, to put your trust in clean, skilful operating and rigid asepsis, and not to allow yourselves to be drawn into the employment of methods which are not founded on sound pathology, and which I believe to be mischievous in practice.

The Deliberate Inclusion of Iris in the Scar. Various methods of attaining this object have been advocated by a number of very distinguished surgeons. To discuss the subject at length would be beyond the scope or the possible limits of the present paper. To my mind these procedures are utterly wrong in principle. Those of you who have followed what I have said under the previous heading, will realize that such a measure as this contravenes what I regard as one of the first principles in connection with the establishment of a filtering scar. Apart altogether from this somewhat negative aspect of the case, there is another side to the question which we must not lose sight of. We have been taught from our student days to dread iris-inclusions in a wound. This dread has been founded, and justly founded, on sound, pathological work, and I regret more than I can possibly express the tendency on the part of able and honored colleagues to resort to a method which seems to me to stand self-condemned at the bar of modern pathology or of modern surgery. Believe me that I speak with the utmost reluctance on this subject, and that I would much prefer to pass it by untouched; but I feel that to

do so, in the face of the strong convictions I hold, would be cowardly and wrong.

(3) *The Safety of the Filtering Scar.* It is obvious that any of the factors which we have already discussed as making for the permanency and efficiency of a filtering scar must add to its safety from the ordinary point of view, but a special significance has been given to the word "safety" in this connection on account of the attention which has been focused of recent years on the danger of "late infection." Two quite different methods have been suggested for the avoidance of this serious complication, (1) the production of a filtering as distinguished from a fistulous scar, and (2) careful attention to the method of preparing the overlying flap. We shall take these in turn.

(1) *The Filtering as Opposed to the Fistulous Scar.* The work of Holth, Lagrange, Verhoeff, the writer, and others has established the existence of a fistulous scar as an indisputable, anatomical fact. The outer opening of the fistula may be, and indeed often is, hidden, by the opacification of the overlying tissues as years pass by; this in no way interferes with the freedom and the efficiency of the fistulization. Holth, the pioneer in the histological examination of fistulous scars, has done more of such work than all the rest of us put together, and his dictum is therefore of no little interest. He says, "after iridencleisis, as well as after sclerectomies, a real fistula through the limbal sclera is seen several years after the operations, if successful." This is a robust statement, founded on anatomical work, and contrasting strongly with Herbert's oft-repeated, but to the author's mind mistaken, conception of a spongy filtering, as distinct from a fistulous scar. Herbert would postulate as the surgeon's desideratum, a sclerectomy or sclerotomy aperture "fully occupied by new fibrocellular tissue." He describes a filtering scar admittedly in the process of contraction, and considers the stage in which he thus encountered it as illustrative of "the final condition of the scars, which are found clinically to filter permanently and satisfactorily." Apart altogether from the fact that such a conception is diametrically opposed to all that pathology has taught us of the behavior of fibrocellular tissue, the important point remains that no anatomical evidence of such a form of scar has ever yet been brought forward, as

the end-result of a glaucoma operation which has proved clinically successful. It is both interesting and encouraging to find Holth, the pioneer and the greatest exponent of this line of work, expressing himself in such unhesitating terms as those quoted above; for, be it noted, this is no academic discussion, but a matter on which the soundness or otherwise of our future lines of operative treatment depend. If the surgeon sees clearly that it is a fistula that he desires, and a fistula that he must have, he will bend all his energies to the attainment of his object under the best possible conditions, and will also be prepared to take certain risks, if necessary, in so doing. If, on the other hand, he allows himself to be misled by the idea that he can relieve his patient by some less drastic procedure, then there is a fear, and more than a fear, that he will be lacking in aim and uncertain in purpose. This is no plea for one form of operation rather than another; it is an appeal to first principles, which we cannot violate without injury to the heritage we are to hand down to posterity. It is for this reason that so much emphasis has been here laid on the subject.

My strong personal conviction is that, if we are to obtain efficient filtration in glaucoma cases, we must aim at fistulization, and that it would be futile to dissipate our strength by efforts to produce a type of scar of which after so many years there is absolutely no anatomical evidence, and the very conception of whose existence is repugnant to what we know of the elementary laws of the behavior of fibrocellular tissue.

(2) *The Method of Fashioning the Flap of a Filtration Scar.* The varying experiences of different surgeons as a result of the employment of presumably the same method of treatment, operative or otherwise, must always furnish a vast amount of material for thought. The conclusions to be drawn will vary widely in different cases. Not the least interesting of the modern chapters of the kind might be written around the incidence of late infection after trephining and other similar procedures. Some operators have had an extraordinarily unfortunate experience, their percentage of disaster being little short of appalling, whilst others, and they too men of large experience, great clinical knowledge, and undoubted honesty, have little or no personal acquaintance with this

dreaded sequel of sclerectomy. It would be difficult to escape the obvious conclusions that very much indeed depends on the technique of the individual operator. I am the more inclined to believe that this is the case owing to the fact that I have met with a number of surgeons who believe that they are doing my operation, whereas they have obviously evolved a technique of their own which differs in essential respects from the one which I have described at length and which I hold gives a strong guarantee of safety against late infection.

Let me here turn aside, at the risk of some slight repetition to state what I believe to be certain elementary truths: (A) A filtering scar to be efficient must depend upon an actual fistula, which places the fluids of the eye in comparatively free communication with the subconjunctival tissue. (B) A fistulous scar, whilst it places the interior of the eye in communication with the subconjunctival tissue, must necessarily involve a certain, even if small, element of risk to the contents of the globe whenever dangerous pathogenic organisms find a resting place, whether for a longer or shorter period, in the conjunctival sac. (C) The moment that the closure of the fistula removes this danger of infection of the interior of the eye from without, the scar ceases to filter and the operation has ended in failure. (D) The best method of protecting the eye from infection through the fistula lies in the careful fashioning of the overlying flap. This last point deserves careful discussion, if only on account of the large amount of misunderstanding which still appears to enshroud it.

The flap that is to cover a filtration scar should be as thick as possible, taking up every available scrap of tissue right down to the sclera; it should also be cleanly dissected with a minimum of trauma; it should be as wide as possible to allow of free filtration, and with the same end in view, it should run concentric with the cornea, provision being thus made for the escape of fluid from the flap into the whole area of the subconjunctival tissue.

The ideal filtering scar should be but slightly raised above the level of the surrounding conjunctiva, sloping off into the latter on all sides, and presenting a flat table-land appearance. It should not be sharply raised, bullous, or vesicular. It is true that, even with careful operating, vesicular scars may

still sometimes be met with, but such occasions should be rare. Even in the thin conjunctivæ of old people it is possible to get beautiful flat filtering scars. It is sometimes suggested—probably by surgeons who have little practical acquaintance with the method—that trephined scars are usually vesicular. Such a statement is a ridiculous travesty of the facts. I see at intervals a large number of my old trephined cases, and am able to demonstrate to visitors and others the large percentage of cases in which ideal flat filtering scars are obtained. Vesicular scars are the exception. The same is true of the experience of a large number of other surgeons.

The Disadvantages of the Vesicular Scar. (1) A bulging scar may be a source of constant discomfort to a patient; in rare cases it may catch on the edge of the lid. On one occasion, when I was examining such a case in which the wall was very thin, the patient made a sudden violent movement, caught the vesicle on the lid edge, and burst it with an audible click. Fluid escaped through the fistula thus formed for some months afterwards and the patient asserts that she was never so comfortable as during that period. (2) Even when there is no discomfort, patients are sometimes alarmed or dissatisfied owing to the scar showing a bulge through the upper lid. (3) The surface of a vesicular scar may become abraded on its covering epithelium and may weep steadily. It has been pointed out that where transudation on a free scale can occur from within, there is always the possibility of infection from without. This interesting subject is nothing like so simple as some writers appear to think. A markedly vesicular scar may present no abrasions (by the fluorescein test) and may not transude fluid, at least to an extent that it is possible to appreciate. On the other hand, a wide, flat scar may, for a time at least, transude fluid abundantly, making the conjunctival sac uncomfortably moist despite the fact that the surface epithelium is intact.

I am not at all inclined to dispute that a filtration scar whose surface epithelium is abraded may be a source of danger to an eye; but I am astonished that any one should regard such a condition as the end-result of an operative procedure of any kind. I regard such a condition as calling for continued active treatment, and do not rest satisfied until the epithelium sur-

face is once again intact. Zinc sulphate, silver collosol, silver nitrate, and other drugs are of the greatest value in the treatment of such cases.

Nor should I be content to stand idly by whilst a patient complained of excess of moisture as a result of transudation even through a healthily covered flap; treatment with zinc salts and with other drugs, tried in turn if one fails, will soon lessen the discomfort the patient is experiencing. Even the marked bulging of a vesicular scar, objected to for cosmetic reasons or on account of discomfort, may be markedly reduced by steady painting of its surface at intervals of four or five days with a solution of a silver nitrate (grs. v to x to thę oz.)

Holth and others appear to have assumed that a weeping vesicular scar is a common occurrence after trephining. If it is so in any surgeon's practice, all I can say is that the technique employed must be defective. I have used fluorescein on a large number of trephined scars, both shortly after operation and months or years afterwards. Even so soon as one week after a trephining, one usually gets no staining of the surface, if the typical, flat, healthy scar is obtained. Sometimes for a few days afterwards, there will be slight staining at the limbus; the use of zinc sulphate drops will usually soon remedy this; if it does not, silver nitrate drops (gr. iii to oz. i) should be tried after the previous instillation of cocaine. It is rarely necessary to use anything stronger. Indeed silver collosol alone will often suffice.

A FEW SUBSIDIARY POINTS REMAIN TO BE CONSIDERED:

Shrinking of the Caliber of the Fistula. A scar that has filtered well for three months may practically be relied on to last indefinitely. Very rarely one sees the freedom of filtration lessen as the years go by and I have under my care one patient in whom a second trephining was called for some years after the first. It is just possible that the explanation of such cases is that the fistula has become blocked owing to the proliferation of connective tissue from its walls, as the result of trauma inflicted at the time of the operation. For what it is worth this is an argument in favor of using sharp instruments during the sclerectomy with a view to obtaining a clean-cut

fistula. It has been suggested that this can be better done with the scissors in the Lagrange or Holth operation, and with the trephine in my own. Such a suggestion is, I hold, utterly unfounded on fact. A really sharp trephine blade has an edge almost like a razor. I would ask any of you who doubt this to take one of the disks cut out by a sharp trephine—a blunt trephine should never be used under any circumstances —and examine it while it is still fresh under a microscope. With regard to the final cut with scissors made when it is desired to remove a part only of the trephined disk, this is obviously just as clean as that of the Lagrange or Holth operation. I merely mention these facts in order to controvert erroneous and ill-founded statements which have been made on the subject.

The Formation of Secondary Fistulæ in the Neighborhood of a Trephine Hole. This phenomenon has been noticed by several observers beside myself. I believe many of you will observe it, if you look for it. It is not rare. The most probable explanation of it appears to me to be that the new channel follows the line of a vessel perforating the sclera in the neighborhood of the fistula.

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PHAKŒRISIS.[1]

The Advantages and Important Details of Technique.

By Prof. IGNACIO BARRAQUER, Barcelona.

WHAT would we say of the surgeon who, in order to extirpate an intraperitoneal cyst, should split its capsule and spill the contents into the serous cavity and then by means of pressure, instruments or by washing, etc., clean the peritoneal folds of the remains of the lesion, leaving necessarily a great quantity of them and the cystic membrane behind? How many patients would suffer from peritonitis! What a large percentage of calamities due to the imperfection of the procedure would result!

Well, then! In practicing a cataract extraction with cystotomy we are doing nothing more than intervening as imperfectly as that, since the chambers of the eye are a serous cavity and the opaque lens represents a cyst, whose contents spilling into the cavity cause inflammation and reactions on the part of the intraocular tissues, opening the field to infection. The cystic capsular membrane, when it is not imprisoned in the lips of the wound, causes ultimate complications and forms a secondary cataract in most cases, which lowers the sight and obliges one to intervene anew. It is then necessary for the ophthalmologist, if he desires to follow the elementary rules of the surgeon, to give up cystotomy entirely. All modifications conceived for the operation of cataract tend to dispose of with a minumum maneuver, the greatest possible quantity of the remains of the lesion, and in practicing a cystotomy we all try to perform the most com-

[1] Read before the Section on Ophthalmology, New York Academy of Medicine, April, 1922.

plete toilet of the wound possible. We desire to approach a total extraction, convinced that this is the ideal one. If the latter has not been generally done, it is through a lack of procedure free from dangers which I shall not enumerate in order not to exceed the limits of this communication. For more than six years I performed hundreds of total extractions by means of the lens extractor. On each day by my statistics I saw the number of accidents and complications decrease proportionally to increasing the number of aphakics with normal visual acuity. My manner of procedure is as follows:

1. Dilatation of the pupil by means of an ointment of chloride of euphthalmine and cocaine 5%.

2. Temporary paralysis of the orbicularis muscle by injection of novocaine 1%.

3. By fashioning an incision in the upper $\frac{2}{5}$ of the cornea with a scleral-conjunctival flap.

4. Application of a suture to the conjunctival flap which will be tied after ending the operation, assuring complete coaptation of the lips of the incision.

5. With Hess's forceps to make a peripheral iridectomy as far as possible from the sphincter.

6. Adaptation of the cup to the anterior surface of the lens.

7. Dislocation of the lens from the patellar fossa.

8. Extraction.

9. Toilet.

10. Eserine and bandage.

The conditions indispensable to secure a perfect success are: The patient must have exactly the necessary dilatation of the pupil; because an excess of mydriasis makes a peripheral iridectomy difficult to perform; a pupil which is too small complicates extraction and exposes to traumatism of the iris, which always should be avoided. During the course of the operation not the least pressure is exerted upon the globe, because one ought always to use temporary paralysis of the orbicularis muscle; avoiding thus efforts that the patient can make by squeezing; not to use a speculum, and to have an assistant practiced in the suitable way of holding the lids, and giving special attention to not compressing the globe with the fixation forceps when making the incision. Any undue pressure or deformation of the globe causes rupture of the

hyaloid and predisposes to loss of vitreous. The extraction should be made quietly and gently without any pressure with the lens upon the patellar fossa, and dislocating it in such a way that its upper border follows from above down.

The intensity of vacuum which we employ with the cup should be exactly measured beforehand with reference to the physical condition of the cataract. In a senile cataract, hard and complete, one can use an intensity of vacuum equal to 60*cc* of mercury, exceptionally 65*cc*, and in partly hard cataracts, milky or half milky and incipient, the vacuum should be diminished in proportion to the hardness. An insufficient intensity does not rupture the zonule, but an excessive suction can rupture the capsule. Every accident from the operation is caused by lack of either surgical technique or foresight. One must be, for this operation, most careful and exact in all small details. An attempt to dilate the pupil ought to be made a few days before the operation, in order to determine the application of the mydriatic ointment, and ought to be done one of more days before operation, which time varies with the patient; and a minute examination of the cataract and zonule by means of the slit-lamp of Gullstrand and the corneal microscope of Zeiss, gives us a way of being acquainted with the physical condition of the cataract and through this the amount of vacuum to use is determined.

To repeat: 1. To perform a successful phakœrisis a previous careful study of the patient is necessary, since each one of the eyes to be operated on requires distinct technique.

2. Knowing how to regulate the lens extractor.

3. To avoid at all costs pressure on the globe.

One should not intervene in subjects under forty, because in them the zonule is still very resistant, nor in a complicated cataract or in one occurring in myopia, in a subluxated lens, in a traumatic cataract or in one ripened artificially by means of a preparatory iridectomy.

In all of the cases which have been done correctly and without accident, the first dressing after six or seven days, fails to excite the least hyperæmia, the pupil reacts perfectly and is pure black, and the patient enjoys full visual acuity.

THE DIAGNOSTIC USE OF THE UVEAL PIGMENT IN INJURIES OF THE UVEAL TRACT.[1]

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IN a former paper(1) by one of the authors, clinical and experimental studies on the immune reactions following injuries to the uveal tract were presented. These studies showed 1. In an intraocular injury involving the uveal tract where normal healing took place without the occurrence of a sympathetic disturbance in the fellow eye, there developed in the blood serum a positive complement fixation reaction to an antigen made from the pigment of the uveal tract. 2. In the cases of the intraocular injury involving the uveal tract when normal healing was delayed, and where sympathetic disturbance in the second eye sometimes occurred, this complement fixation reaction to pigment antigen was absent. Furthermore, there was not only the absence of this complement fixation reaction, but in one case of sympathetic disturbance, there appeared to be a definite hypersensitiveness to pigment. Evidence was also presented which led the author to believe that the occurrence of this complement fixation reaction was evidence of the development of an immunity by the organism to the pigment, and gave definite protection against the outbreak of a sympathetic disturbance in the fellow eye. Further, it seemed clear that the failure to develop this complement fixation reaction was evidence of the failure to develop an immunity, and was so attended by a persistence of in-

[1] Presented before the American Ophthalmological Society at Washington, May 3, 1922.

flammatory symptoms and the liability to the development of a sympathetic disturbance in the fellow eye.

The possible clinical use of this phenomenon for the purpose of early information as to the prognosis, in any given case of intraocular injury involving the uveal tract, is at once evident. Should these facts hold true, the development in the blood serum of a positive complement fixation against pigment antigen, would warrant the surgeon in giving a favorable prognosis, and allow him to leave the injured eye without fear of the development of a sympathetic disturbance in the fellow eye. On the other hand, the failure to develop a positive reaction would give definite information to the surgeon that sympathetic ophthalmia was an event to be feared, and would allow removal of the injured eye before the outbreak of the sympathetic disease.

It is the purpose of this paper to report cases of intraocular trauma involving the uveal tract, in which this serum complement fixation reaction against uveal pigment was used as a diagnostic procedure to determine the status of the case as regards the possible outbreak of sympathetic ophthalmia.

THE DIAGNOSTIC USE OF UVEAL PIGMENT ANTIGEN IN THE SERUM COMPLEMENT FIXATION REACTION.

The serums from seventeen cases of intraocular injury involving the uveal tract, occurring in the private and dispensary practices were examined in the complement fixation reaction against an antigen of uveal pigment. The technique of the reactions and the preparation of the antigen have been previously reported.(2)

Grouping these cases according either to the results of the reaction, or the clinical picture and result, they fall into three rather general groups. The first group comprises ten cases which gave a positive complement fixation reaction, and which healed without the occurrence of any sympathetic disturbance. In three of these cases, however, for one or another reason enucleation was performed. The second group comprises three cases which all showed negative complement fixation reactions and at the same time showed more or less severe signs of a sympathetic disturbance. The third group

comprises three cases which showed alarming symptoms in the injured eye but without any manifestation of sympathetic disturbance in the second eye, and gave negative reactions.

GROUP I.

The following reports are of the cases in which following wounds of the uveal tract the blood serums showed positive complement fixation reaction against pigment antigen.

No. 1.—Struck in left eye April 16, 1921, by a piece of steel. Wound of entrance lower corneal margin. The splinter of steel passed back through the iris and was localized by X-ray, in the region of the lower ciliary processes. Size of splinter was 12 x 2 *mm.* Removed by magnet extraction April 17, 1921. Serum reaction against pigment antigen on May 2, 1921, was + + + and May 21, 1921 + + +. Injured eye gradually underwent phthisis. In March, 1922, injured eye was small, sightless, and not inflamed. Right eye held $\frac{20}{15}$ vision throughout and has remained free from trouble to date.

No. 2.—Struck in right eye by a flying piece of steel, June, 1921. Wound of entrance, cornea-scleral border. X-ray showed intraocular splinter of steel 13 x 3 *mm.* Successfully removed by magnet extraction on June 14, 1921. Serum reaction against pigment antigen on June 25, 1921 was + + +. Injured eye healed quickly and retained $\frac{20}{40}$ vision. Left eye held normal vision and has shown no subjective or objective signs of disturbance.

No. 3.—Struck in right eye on Sept. 14, 1921. A perforating wound of cornea with prolapse of iris and ciliary body resulted. Prolapsed tissue was abscised within three hours after accident, scleral suture and conjunctival flap were made. Uneventful healing, but a phthisical eye, resulted. Serum reaction on Oct. 1, 1921 was + + +. There was no disturbance of any type in left eye, but on Oct. 26, 1921 right eye was enucleated for cosmetic reasons.

No. 4.—Struck in right eye Dec. 14, 1921, breaking patient's spectacles. There was a perforating wound of right eye, involving cornea, iris, lens, and ciliary body. Prolapsed tissue was abscised after accident. Traumatic cataract developed and was removed.

The eye showed a continual cyclitis of varying intensity

which finally, starting about the middle of February, gradually subsided with a retention of $\frac{4}{8}$ vision, with correction.

The following were the serum reactions in this case:—Dec. 14, 1921, = ±; Jan. 9, 1922, = + +; Jan. 21, 1922, = negative. Feb. 13, 1922, = + + +; March 27, 1922 = + + +.

Vision in the uninjured eye was $\frac{4}{8}$ at the time of the accident. There has at no time been any failure of the visual acuity or field or disturbance of any kind.

This case is of especial interest in that recovery was delayed, and with this delay, the patient passed from a positive phase to a negative phase and finally to a second positive phase which has been steadily maintained.

No. 5.—November, 1921, while hunting, was struck in right eye with spent shot. Treated at home.

Exam.: X-ray: bullet down and in. Iridocyclitis and detached retina below.

Treatment: Enucleation. 12–11–21.

12–20–21. Discharged. Normal recovery.

12–11–21. Serum reaction against uveal pigment + +.

No. 6.—Nov. 15, 1921. Struck in left eye with piece of glass.

Exam.: "X" shaped penetrating wound in temp. side over region of ciliary body, the wound being 4–6 *mm* long (Nov. 16, 1921.)

Treatment: Scleral wound sutured—conjunctival flap.

Course: Looked very well for first ten days then eye became red—ciliary congestion—iris showed greenish discoloration—Vit. exudate. T—

12–9–21. Enucleation.

12–16–21 Discharged. Right eye normal.

Dec. 15, 1921. Serum Reaction against uveal pigment. ±

No. 7.—Dec. 21, 1921, while playing with knife it struck him in the eye.

Exam.: Perf. wound of cornea starting a few *mm* above limbus at 12 o'clock and running downwards for about 8 *mm*. Iris cut above. Some vitreous in upper part of wound. Lens swollen.

Treatment: 12–28–21. Adm. to hospital.

12–28–21. Wound cleaned up and some of cataractous lens let out.

Course: 1–6–22. Serum reaction against uveal pigment negative, no immunity.

2–4–22. Serum reaction against uveal pigment + + +.

2–17–22. Discharged. Ran through a long drawn out iridocyclitis with remissions and relapses. On exit left

eye nearly white. Considerable cortex remaining. Capsule adherent to cornea and iris to capsule. V. R. $\frac{20}{30}$ L.HM.

3–20–22. Iridectomy.

4–15–22. Discharged. Normal recovery.

No. 8.—1–19–22. While on street was struck by some unknown object in right eye.

Exam.: Linear incision through cornea from 9 to 5 o'clock and extending into C.B. Iris prolapsing, also part of C.B. and some vitreous. V. = P.L.

Treatment: Prolapsing iris C.B. and vitreous abscised. Wound closed with scleral and conjunctival flap.

Course: Made normal recovery. Discharged 2–7–22. Vision $\frac{20}{100}$. When last seen in clinic V. $\frac{20}{50}$ +. Eye was white. No pain, left eye normal V. $\frac{20}{30}$.

Serum reactions against uveal pigment:

2–1–22. Negative.

2–13–22. Anti-complementary.

2–28–22 +

No. 9.—Sept. 1921 struck in right eye with splinter of steel. Three weeks ago noticed right pupil larger than left.

Exam.: Corneal scar lower nasal quadrant with laceration of iris and opacity of lens directly behind. Imbedded in retina 3 disk diameters below disk there is an oblong foreign body surrounded by degenerated retina and choroid. Numerous small retinal exudates surrounding foreign body. V. $\frac{20}{30}$.

Treatment: Giant magnet extract through zonule and A. C.

Course: 2–11–22. Serum reaction against uveal pigment +

2–17–22. Vitreous hazy. Some œdema and cloudiness about old choroidal scar.

2–25–22. Discharged. V. 20–70. Eye white. Vit. clearer. Fundus unchanged.

3–16–22. Readmitted. Detachment of retina below. V. R. $\frac{10}{200}$; L. $\frac{20}{20}$.

Left eye normal.

No. 10.—Jan. 2, 1922, left eye injured by wire in coasting. Prolapsed iris abscised. Eye has remained red. Shrunken. No pain.

Seen on Feb. 6, 1922. Ciliary congestion. Iris discolored. Scar in cornea on temporal periphery. Somewhat indrawn. Beginning phthisis, faulty projection.

Serum reaction Feb. 13, 1922: + + +.

No. 11.[1]—Feb. 2, 1922. Was struck in right eye by nail. He withdrew nail following accident.

Exam.: V. HM. Perforating wound of cornea in lower nasal quadrant. Iris cut and caught in wound. Lens cataractous. P. L. good.

Treatment. 2–6–22. Wound freed of iris.

Course: 2–14–22. Anterior synech. at site of injury some exudate back of lens. Eye very red.

2–25–22. Serum reaction—negative. No immunity.

3–15–22. Discharged. Eye still very red. T. N.; V. $\frac{10}{200}$; L. proj. N.; lens sublunated and cataractous.

4–18–22. Eye still red. No pain. T. N.: V. HM. L. eye normal.

GROUP II.

The following reports are of cases in which the following injuries of the uveal tract, the blood serum showed negative complement fixation reactions. These cases showed either at the time of serum reactions, or developing later, disturbances in the second eye which were believed to be sympathetic in nature.

No. 12.—Shot in head Aug. 30, 1921, with a shotgun. Many shot penetrated skull and one shot penetrated left eye, passing through eyeball and lodging near nasal wall of orbit. Craniotomy was performed Sept. 3, 1921, with removal of many shot. Iridectomy was performed on left eye on Sept. 9, 1921, for removal of iris tissue incarcerated in wound of entrance. Serum reaction on Sept. 8, 1921, was negative. Serum reaction on Sept. 30 was still negative. The eye was still inflamed, and sightless. Enucleation was advised and refused. The child returned to his home in Virginia on Oct. 1, 1921. On Oct. 7th an attack of photophobia with pericorneal flushing in the right eye was reported by the local physician. The child was brought back to Baltimore on Oct. 14, 1921. At that time there was still decided photophobia but the eye was otherwise objectively negative. Serum reaction on Oct. 14, 1921, was negative. Enucleation of left eye was performed on Oct. 16, 1921. Following enucleation, the photophobia of the right eye disappeared, and the eye has remained entirely normal since then.

No. 13.—Penetrating wound, left eye, 1909. Normal healing with retention of $\frac{2}{10}$ vision. In May, 1921, some

[1] (Case incomplete—no serum reaction has been done since negative reaction of Feb. 25th. Case is still under observation, and is included in this series, insomuch as the report includes all cases tested up to March 15, 1922.)

solder flew up in left eye causing great pain which steadily persisted. Right vision began to fail in July, 1921. On examination Aug. 23, 1921, the left eye showed a displaced pupil, back of which, bulging the iris forward, a foreign body could be distinctly seen. There was a low grade cyclitis, tension was normal, vision $\frac{20}{70}$. The right eye showed nothing objectively except marked vascular congestion of the fundus and slight photophobia. Vision was $\frac{20}{20}$— with correction. Visual fields showed normal field in right eye and concentric contraction in left. A complete medical study at Johns Hopkins Hospital showed only negative results. Laryngological and all other special examinations were likewise negative. On Aug. 26, 1921, the serum reaction with pigment antigen was negative. A tentative diagnosis of sympathetic irritation in the right eye was made and enucleation of left eye advised. The patient returned to his home in North Carolina where enucleation was performed, and patient reported that following enucleation all symptoms in right eye cleared.

No. 14.[1]—Boy aged 8 years. Patient was seen first Sept. 10, 1921, at which time right eye showed an unhealed corneal ulcer with prolapse of iris in a dense scar in lower half of right cornea. Condition appeared to be the result of a gonorrheal ophthalmia, which had begun 3 months previous. V. = L. P. Tension +. *Sept. 13th* operation, iridectomy upward, defect in cornea curetted, prolapsed iris removed and conjunctival flap made. Uneventful healing. Patient was discharged on Sept. 27th. R. V. $\frac{20}{200}$, L. V. $\frac{20}{20}$. *Oct. 31st.* Patient returned with ciliary congestion of left eye, posterior corneal deposits and posterior synechiæ. The injured (right) eye showed corneal defect covered by conjunctival flap, and low tension. Special examinations were negative except for some evidence of intestinal fermentation. All treatment, including colon irrigations, etc., were without results. *Nov. 9th.* Right eye was enucleated. This was without effect on the left eye which ran a typical course of sympathetic ophthalmia,—nodules in the iris, peripheric retraction of iris, complete posterior synechiæ, capsular opacity of lens, elevated tension.

Serum reaction: Dec. 21, 1921, completely negative.

GROUP III.

The following reports are of three cases in which the serum reaction was negative and in which the injured eyes were enucleated as a precautionary measure.

[1] This case was later treated with uveal pigment as a therapeutic procedure. Full details will be reported.

No. 15.—Struck in left eye with a bit of steel Dec. 12, 1921, penetrating wound through ciliary body with intraocular retention of piece of steel. Removed by magnet extraction on the same day. Eye was sightless, and showed continual low grade cyclitis with periodic violent relapses. All medical examinations were negative. Radiograph showed no further intraocular foreign body. *Jan. 17, 1921*, and *Feb. 15, 1921*, the serum reactions against pigment antigen were negative. Left eye was enucleated on Feb. 21, 1921. Right eye was normal.

No. 16.—Nov. 1911 was struck by tree branch causing perforating injury for which he has been treated in his home town until Jan. 13, 1922.

Exam.: Marked pericorneal congestion. Perforating corneal wound just below center. Iris greenish and adherent to wound. Pupil occluded. P. L. good. V. L. $\frac{10}{10}$.

Treatment: Enucleation with fat implantation, 1–14–22.

Course: 1–26–22. Discharged. Normal recovery. V. L. $\frac{10}{10}$. Serum reaction against uveal pigment, 1–20–22: negative.

No. 17.—Shot in right eye with B.B. shot May 14, 1921. Shot penetrated glove through upper lid and sclera above cornea.

Treatment: Adm. to Hospital and discharged as soon as hæmophthalmos had cleared up (6–9–21).

Course: Came to clinic for observation. Had several intraocular hemorrhages. T. gradually became soft and the eye remained red. Light projection faulty.

1–6–22. Serum reaction against uveal pigment. Negative.

1–10–22. Adm. to Hospital. Enucleation. Shot found outside globe but adherent to it near optic nerve.

When last seen 4–18–22. Left eye normal, V. $\frac{10}{10}$.

There were two other cases in which the serum reactions were negative, but these cases are of academic interest only. They were both cases of old sympathetic ophthalmia which had finally subsided following enucleation of the exciting eye. One case followed subconjunctival scleral rupture and showed a sympathetic ophthalmia in the second eye which gradually recovered following enucleation of the injured eye. It is of interest that this patient showed a positive, intradermal tuberculin reaction, confusing the diagnosis. The second case was one of delayed sympathetic ophthalmia

in the left eye, following a bayonet wound of the right eye. When seen one year later the left eye was nearly sightless. The right had been enucleated at the time of the sympathetic disturbance in the left eye.

COMMENT.

In these cases above reported, it is frankly admitted that the presence or absence of a positive complement fixation reaction was not the sole index which governed the decision as to whether or not an injured eye should be left or enucleated. In two cases enucleation was performed before the blood was taken for the serum reaction, which in both cases was found positive. In other cases the presence of a positive serum reaction lead to the temporary postponement of enucleation, which was later permanently abandoned on account of the favorable outcome of the case. Yet an analysis of those cases which gave positive results, excluding the two cases in which the picture is confused owing to enucleation having been performed prior to the discovery of a positive blood, shows a rather significant fact. Had we relied, in these cases, upon a positive serum reaction as the index of when not to remove an injured eye, our faith would have been justified. In other words, the occurrence of a positive serum reaction, irrespective of the condition of the injured eye at the time the reaction was done, was always followed in time by a subsidence of inflammation without any manifestation of sympathetic disturbance.

Whether the opposite of this is true—that a negative reaction is sufficient indication to remove an injured eye for fear of a possible sympathetic ophthalmia—is not so clear. Of the seven cases which showed negative reactions, one is still under observation and three, at the time of the serum test, already showed signs of a sympathetic disturbance. In the remaining three cases, we did not wait for a possible sympathetic disturbance to develop—the injured eyes were enucleated. But these three cases all showed a long-standing, chronic cyclitis, the eyes clinically appearing dangerous. So in all three enucleation was justified by the clinical symptoms alone.

In the absolute interpretation of negative results, other factors must be considered. In the first place the blood serum practically never becomes positive before ten days after the injury, and frequently never becomes positive before four weeks. Furthermore, as is illustrated by case No. 4, Group 1, the patient may go from a positive phase to a negative phase, and then finally to a positive phase. If a single, or two, negative reactions were taken as a definite indication for the removal of an injured eye, eyes might so be needlessly removed, for in a few weeks more it is possible that the patient might go into a permanent positive phase, and be automatically protected against sympathetic ophthalmia. Therefore, if the serum reaction is negative, the time interval after injury must be first considered. However, if six weeks after injury the patient has failed to develop a positive reaction, it seems unlikely, from the information we now have, that a positive reaction will ultimately develop. In such cases the possibility of sympathetic ophthalmia and enucleation of the injured eye should be carefully considered.

There is one further point to be considered in the interpretation of positive results. That point is this:—Is the immunity indicated by a positive reaction permanent, or is the immunity likely to fail and the patient later becomes susceptible to sympathetic ophthalmia? This question is very difficult to answer. We have seen one, and only one, case go from an initial positive phase to a negative phase, and this patient later, within three weeks after entering the negative phase, again became positive, and has so remained. An immunological fact is known which may be somewhat analagous to this reaction. In an animal experimentally immunized by repeated injections of foreign protein, each fresh injection is followed by a temporary decrease in the anti-body titer. If the original titer is not very high this decrease may throw the animal from a positive to a negative phase. This reaction is followed, however, by a further increase over the original titer, so the animal soon again becomes more positive than before.

Every other case examined which showed a positive reaction, so far as our work has gone, has remained positive. Yet the following fact is true. In the earlier work in man with

this complement fixation reaction, most of the cases tested were cases where the traumatism was one year or more old, and it must be admitted that positive reactions in these cases were weaker than in the more recent cases. From a review of the work previously reported, it seems clear that immunity, once definitely established, will last from two to three years, and probably much longer, but gradually will become weaker.

Summarizing the results shown by the cases here reported, which showed positive reactions, considered in the light of our previous studies, it seems probably that a positive reaction indicates a definite immunity to the development of sympathetic ophthalmia and that this immunity will last at least several years, if not permanently. From these findings it seems, then, that with the occurrence of a positive serum reaction, unless the clinical condition clearly contraindicated such a course—that the surgeon is warranted in not enucleating injured eyes.

SUMMARY.

The immune reactions which follow intraocular injuries involving the uveal tract of the eye were used in seventeen such cases as a diagnostic procedure. In ten cases the complement fixation reaction was positive. These cases showed a normal healing without the occurrence of any sympathetic disturbance. One case is still incomplete. Three cases showed negative reactions, and of these one showed clinically a malignant sympathetic ophthalmia, and two showed definite signs of sympathetic irritation. The three remaining cases showed negative reactions, and in these cases the injured eyes were enucleated as a precautionary measure. The other cases of old sympathetic ophthalmia showed negative reactions.

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ROENTGEN RAY STUDIES OF THE NASOLACRIMAL PASSAGEWAYS.[1]

By Drs. DON M. CAMPBELL, JOHN M. CARTER, and HOWARD P. DOUB, Detroit, Mich.

(*With three illustrations on Text-Plate XIX.*)

THE purpose of this paper may be given under four headings:

1. To give a short outline of the various methods used in treating stenosis and infection of the nasolacrimal passageways.

2. And chiefly, to give in detail a method for examining these passageways by means of the roentgen ray.

3. To present certain data which have accumulated in the course of our X-ray studies of some sixty cases in the past year.

4. For the sake of completeness, a preliminary report is given of 10 cases with complete obstructions that have been operated during this period.

Permanent relief of infections and of stenosis of the nasolacrimal passageways, with their attending complications, is a problem of first importance to the oculist and the rhinologist. A patient seldom brings a more annoying or troublesome complaint to his physician than the constant drainage of tears over the lid margins. In fact, few things can be more disconcerting or discountenancing than a "watery eye." Constant tearing makes reading a hardship and the doing of close work next to impossible. Also, the poor drainage for the tears predisposes to the growth of bacteria about the eye and to abscess formation in the lacrimal sac. This last condition is a constant source of danger to the integrity of the eye. If a "watery eye" is troublesome, then a "pusy eye" must be next to intolerable, and we find that our patient will go to almost

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ILLUSTRATING DR. DON M. CAMPBELL, DR. JOHN M. CARTER, AND DR. HOWARD P. DOUB'S ARTICLE ON "ROENTGEN RAY STUDIES OF THE NASOLACRIMAL PASSAGEWAYS."

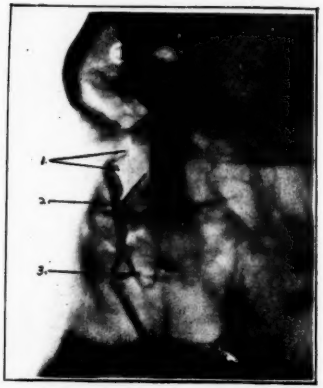

FIG. 1.—NORMAL PASSAGEWAYS.

(1)—Upper and lower canaliculi entering the sac separately (the exception to the rule.

(2)—Silver rider over the root of the middle turbinate, showing the passageways just anterior to this structure. The rider also marks the lower end of the sac in this case.

(3)—Showing the course of the bismuth and the narrowing of the lumen of the duct as it enters the inferior nasal meatus. (The greatest constriction is not at the junction of the sac and duct as is usually stated.)

Case No. 25358—Mr. T. H.

FIG. 2.—COMPLETE OBSTRUCTION.

(1)—Lacrimal sac with complete obstruction at the lower end.

(2)—Silver rider over root of the middle turbinate.

(3)—Bismuth stripe on anterior end of the middle turbinate.

Note:—The obstructed sac is well above and just anterior to the turbinate, a point of value when operating intranasally. It is difficult to see why the anterior end of the middle turbinate should be removed in any operation on this sac.

Case No. 31048—Mrs. M.

FIG. 3.—OPERATED CASE WITH SATISFACTORY DRAINAGE.

(1)—Upper and lower canaliculi.

(2)—Cupalo (upper limit of sac).

(3)—New opening made from sac into middle meatus. This is well placed and of a good size.

(4)—Bismuth in the right nasal passage.

(5)—Point of obstruction.

Case No. 27809—Mr. R. C.

any extreme to obtain relief. How can this best be accomplished?

Methods of treatment advocated and some of the objections offered to the various procedures may be divided into three groups.

First group: Those which seek to correct the stenosis by introducing instruments (such as probes) through the canaliculi or by cutting and curetting the strictures.

Objections: These procedures are very painful and must be continued for a long period of time and for these reasons if for no other the percentage of failures will be high.

Second group: Those advocating the removal of the sac or its destruction by a caustic.

Objection: These procedures, although ridding the patient of the infection, do not provide for the drainage of the tears into the nose.

Third group: Those operations which attempt to drain the tears and to clear the abscessed or infected sac by establishing free drainage into the nose. The usual procedure here is to short-circuit the tears through the sac into the middle nasal meatus. West (1), who was one of the first to accomplish this by intranasal operation, made a large window in the lateral wall of the nose opposite the position occupied by the middle and upper third of the nasolacrimal duct.

The earlier operations were done, not by the intranasal route, but through an incision made in the skin over the sac. Toti (2) described such a procedure in 1904.

The chief causes for failure reported for both the external and intranasal methods are: (1) poor function in one of the puncta, usually due to slitting the lower one; (2) small sclerotic or obliterated sac; (3) failure of the new avenue of drainage to remain open, or to give proper drainage because of its having been placed in a wrong position.

It at once becomes apparent that if the operation could be approached knowing the exact location of the obstruction and size and condition of the sac, and if, after the operation, the size and exact location of the opening made on the inner wall of the lacrimal sac could be known, a step forward would be made in the effort to solve our problem. It was with these points in mind that the present work was undertaken. In the past

year we have made X-ray studies of some sixty normal, obstructed, and operated passageways. It is the chief object of this paper to indicate some of the practical significance of such data.

We would also emphasize the fact that, so far as our experience goes, there is no harmful effect associated with the procedure, either in its use in the normal or in the obstructed passageways. It is only fair to add that the injections to be described soon in this paper, should be made by one who is familiar with the technique of syringing the lacrimal apparatus and that care should be taken not to make our injections subcutaneous.

Method of Bismuth Injection and X-raying.—The method of procedure has been first to undertake the usual routine of attempting to syringe solutions by way of the puncta through the sac and duct, into the nose. After this, the passageways are injected with oil and bismuth and X-rays taken in the lateral and in the postero-anterior position.

The following is the technique in detail A few drops of 2% cocaine are dropped into the lower cul-de-sac. Any mucus or pus which may be in the sac is expressed by pressure. If desired, the puncta to be injected may be dilated slightly, but under no circumstances should the canaliculus be slit. The passages are then syringed out with a normal saline solution to which a few drops of 1:0000 epenephrim solution have been added. After this the passageways are injected with Beck's bismuth and oil paste. For this last we use an ordinary 2*cc* all-glass Luer syringe and No. 19 needle which has been filed blunt. In the progress of our work it has been found desirable in certain cases to obstruct the puncta, which is not being used in the bismuth injection. For this purpose a medium sized common pin is placed in the puncta selected. Less than 1*cc* will be required to inject the unobstructed passageways, while about ½ *cc* will suffice in those with obstruction. In trying to locate the sac relative to the intranasal structures, we have found that the placing of a small silver rider over the anterior end of the middle turbinate just below its attachment to the lateral wall of the nose is of considerable value. Recently we have outlined the position of the entire anterior end of the middle turbinate by a stripe of bismuth which is easily applied, using

a long lacrimal needle. The lateral X-ray plate will then show how much of the unobstructed passage lies above or below the root of the turbinate, also whether it is in front or back of the turbinate. The marker has not been used in all our cases, but that it is a procedure of value has been clearly demonstrated.

Studies Made of the Passageways. The patients complain of little or no discomfort from the injection of the bismuth. We are in the habit of asking the patient to return in two days following the X-ray, at which time any bismuth which may remain in the passageways can be easily syringed out. Our experience has been that those cases without obstruction will, as a rule, show no bismuth, while those with obstruction will have more or less bismuth in the passages. In the study of the radiograph the two lacrimal canaliculi are seen as they pass from the free margin of the upper and lower lid, running at first vertically for a short distance and then turning at right angles to become directed medially in a convergent course toward the lacrimal sac. Into this they empty either separately or after having united to form a short common trunk. One or both of the canaliculi may be occluded either congenitally or as the result of inflammation and cicatrix. The X-ray is of value in showing just where and to what extent these small passageways have been involved. Next is noted the outline of the normal sac, the anterior-posterior diameter of which when injected is 5 to 10*mm* and the length of which is 12 to 16*mm*. Normally the nasolacrimal duct is a direct continuation of the sac with an end to end union. However, there may be a side to side joining; we have seen several such cases in this series. The average length of the duct is about 25*mm* and it has a diameter, when injected, of from 1 to 8*mm*. The narrowest portion of the duct is, as a rule, at its opening into the nose, and not at the junction with the sac as is usually stated.

In a diseased or obstructed sac we may have one of two extremes: First, the sac after prolonged obstruction may be greatly enlarged and dilated just as is seen in the gall-bladder with biliary stasis. Second, the sac may be very small as the result of repeated abscess formation and cicatrix, or it may show any of the intermediate forms. The largest sac we have

seen measured *22mm* while many of the contracted ones measured less than *3mm* in length. One of our cases showed a fistula leading into the soft tissues of the face, while another showed a fistula leading into the ethmoid labyrinth. Indeed, since these studies were undertaken, von Szily (3) has reported two cases of internal fistula of the lacrimal sac in which the X-ray was of value in making the diagnosis.

Besides those cases with complete obstruction, we see many cases with partial obstructions, complaining of tearing and even pus formation in the sac. The X-ray in this instance is of special value,—1st, because the site of the beginning obstruction is accurately located; 2d by the radiograph we are able to determine the anatomic type of the passageways. Is the duct regular in contour, or is its course angular and not suitable for probing? We have repeatedly noted, in the course of these studies, that the duct on one side may be regular in form and of a good size, while the duct draining the opposite eye may be grossly malformed and of a small lumen.

Variations and Anomalies of Genetic Origin.—Variations and anomalies in the nasolacrimal apparatus are usually readily explained by a consideration of the embryology of these passageways. Congenital absence of one or both puncta may be due to failure of the lacrimal sprout to reach the free border of the lid, or again it may be due to faulty lumen formation in the solid epithelial cord after it reaches the free lid margin. Multiple puncta are encountered, there being two, three, or even four puncta, depending on the number of sprouts to reach the lid margin. In this series we have seen one case with two puncta on the lower right lid. Congenital fistulas and diverticuli of the lacrimal sac may exist, and as they always connect with the main passageways they are easily recognized by the X-ray.

The nasolacrimal duct is subject to much the same variations as those just described for the canaliculi and sac. Its outlet, the passage leading into the inferior meatus of the nose, may be represented by one or by multiple openings, the size and position of which may vary greatly. The single osteum is of course the more common. Again, the duct may fail to establish communication with the inferior nasal meatus,

the outlet being occluded by a membrane, or by bony structure. The duct may have an opening into the middle nasal meatus as well as the lower one. The nasolacrimal duct is, as a rule, regular in contour; however, it may show many twists and irregularities, with fistulas and diverticuli. The two canaliculi, the lacrimal sac, and the nasolacrimal duct may present a most bizarre appearance, malformed, snarled, and very grotesque in their contour. It is when faced with the radiograph of such a case that one is most strongly convinced that the passing of a metal probe would not only fail in relieving the stenosis, but would, most likely, create a false passage and leave the patient in a more deplorable condition than when he consulted us. The same criticism may be offered to any of the intranasal operations, which require the passage of metal probes into the inferior nasal meatus.

There are possibly as many variations in "the anatomic type" of the nasolacrimal passageways as there are in the mastoid. Just as the success or failure of non-surgical methods of dealing with acute middle ear and mastoid antrum infections depends in no small degree upon "the anatomic type" of the mastoid and its appendages, just so the "anatomic type" "looms up" in the treatment of the diseased nasolacrimal passages. J. Parsons Shaeffer (4), who is a well-known authority on this subject, in his latest writing laments that there is no way of knowing "what type of duct confronts the operator." We believe that much of the uncertainty can be eliminated by the X-ray.

It is a well-known fact that disease of the nasolacrimal passageways is very infrequent among certain races, notably the negro. We have repeatedly noted, in X-raying the normal passageway, that the nasolacrimal duct is straighter and much wider in the black than in the white race. To this may be ascribed the negro's immunity to acute dacryocystitis. Santos-Fernandez (5) has arrived at a similar conclusion based on anatomic studies.

Operative Cases and Data. In the past year we have operated ten cases of complete obstruction of the lacrimal passageways, following the intranasal method described by Wiener and Sauer (6). We are quite conversant with the fact that the time is far too short to permit of a final statement as to the end

result. All of the ten cases have been seen in our office in the past two months and we are safe in saying that we have never seen patients more pleased or grateful; all have estimated their improvement at 95% or better, and by far the great majority have obtained complete relief. This statement can best be illustrated by reporting in detail our first case.

Mr. P. (Case No. 18135), a young man 27 years old, came into our office February 6, 1920. Chief complaint, troubled with tearing from both eyes for past 6 or 7 years. Had an abscess in the left sac four years ago. This was incised and later removed at Mayo's. Has had no further trouble with abscess formation in this eye, but is continually annoyed by the tears collecting and draining over the lower lid. X-rays taken by us showed the sac had been completely removed. Patient has had the right duct probed many times with no improvement. Our examination showed the right lacrimal passageways to be completely obstructed. Solutions could not be syringed into the nose, the sac was filled with pus, the lower canaliculus had been slit, and there was a moderate degree of argyrosis or staining of the skin on the lower lid from former injections.

The patient refused to have the sac removed because of the trouble he has had with the tearing in the left eye since it was so operated four years ago.

We operated the right sac intranasally, some twelve months ago. The same has remained open. The patient is requiring no treatment and is now having no trouble with tearing in this eye. Tears continue to pour over the lower lid of the left eye. The case offers a beautiful contrast between the two methods, enucleation of the sac and intranasal drainage. We are aware that the criticism may be offered that our new opening may close. This we cannot deny, but we can say that it has shown no tendency to close thus far, and that should it close, it can be easily opened again. In our present state of mind we would hesitate to advise the destruction or the removal of the lacrimal sac, with one possible exception, namely, those cases where the sac is infected and one of the major intraocular operations is to be performed on the eye involved. In such a case we must strive to have a sterile field, and this is possibly best assured if the infected sac is completely removed and the two canaliculi sealed with the cautery.

Post-Operative Data.—We have found the X-ray of considerable value in two groups of post-operative cases.

First, those cases in which the sac has been removed, but which later return complaining that they are able to express

pus from the lacrimal fossa, or may even have had an abscess. Such a complaint would seem to be prima-facie evidence that some of the sac remains. Here the surgeon must feel that the attempt to destroy or to remove the sac has not been as complete as was originally planned by radical surgery. This may not be so great a catastrophe as would seem at first thought. In fact, it may work as a great benefit to our patient. If enough sac remains, it may still be possible to do one of the short-circuit operations, and thus clear the sac of infection and establish a more or less normal drainage of the tears into the nose. If the short-circuit operation is not considered feasible, it is then necessary to undertake to remove or to destroy the remaining portion of the sac. In either procedure it is of the greatest value to know how much sac remains and where it is located. This data can be easily obtained by X-raying the sac after the injection of bismuth. The second group includes those cases which may not progress satisfactorily after one of the short-circuit operations. Here the X-ray will show us where the new drainage is at fault and enable us to plan for its correction.

As these studies have progressed, many questions have occurred which we believe the X-ray will aid in answering.

Are all cases of complete lacrimal obstruction suitable for intranasal drainage?

Is the sac which is extremely small and contracted one which should be enucleated, or can it be drained into the nose? Our experience has been that the small sac can be successfully drained into the middle meatus of the nose and that the radiograph showing the location of the sac in reference to the intranasal structures is of great value when one undertakes to open intranasally these small and contracted sacs.

To take the other extreme, the greatly dilated and atonic sac, or even one of the intermediate forms, what is the method of choice here? Does it depend in any way upon the location of the obstruction, or upon the ability of the sac to perform the function normally ascribed to it, that of pumping the tears down the nasolacrimal duct? If so, the X-ray will be of value, first because it will show the location of the obstruction, and second because it will show the size of the sac and give us some idea of its condition. With the normal pumping action of the

lacrimal sac greatly impaired or completely lost as the result of prolonged dilatation, is it not better surgical judgment to resect and drain the lacrimal secretion into the middle meatus of the nose, rather than to persist in our efforts to carry the tears down the long and narrow nasolacrimal duct? Is it necessary in all cases to resect the anterior end of the middle turbinate as is advised by Mosier?

To summarize: It has been possible by these X-ray studies to demonstrate on the living subject:

1. That the nasolacrimal duct and sac may have a side to side joining.

2. The passageways on one side may be very malformed and irregular in their course, while those draining the opposite eye may be regular in contour.

3. The passageways in the black race are, as a rule, much wider and more regular in outline than are found in the white race.

4. The lacrimal sac may as the result of infection and obstruction be extremely dilated, or again it may be very small and contracted, and also there may be fistulæ leading from the sac.

5. By the method herein described it is possible to easily demonstrate the position the lacrimal passageways occupy relative to the middle turbinate.

It would seem that we are justified in concluding that satisfactory X-ray data on the nasolacrimal passageways showing the point of obstruction, the size of the sac, and its position relative to the intranasal structures is of practical value in that it allows us to make a more accurate diagnosis and to plan our relief with greater precision.

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FURTHER OBSERVATIONS OF PROTEIN INJECTIONS IN SEVERE OCULAR INFECTION.[1]

By Dr. BEN WITT KEY, New York.

IN responding to the invitation of our secretary, that I present to you some further observations on protein effects in ocular infection, I confess my hesitation and temerity when I view the present broad scope this subject has recently assumed in all branches of medical study. On the other hand I am of that school which believes in clinical results, however empirical the remedy may seem, and I therefore would offer to you for consideration and discussion some observations, which have been the seat of real interest and study, constant attendance and care, and yet of firm self-abnegation, patient but distrustful course of experiment. Mills attempted to base the law of causality upon an inductio per enumerationem simplicem, as an expedient to reduce presuppositions in an indirect way to empirical truths. And yet it is certainly quite evident that only by induction through enumeration can the real value of protein therapy be determined. With this end in view, I am prepared to report briefly to you certain cases of severe ocular infection which I have regarded as indicating a definite protein effect, also reports of cases observed recently by others who have employed this method of combating ocular infection, and finally, I would point out what has been characterized as the non-specific reaction and its probable mechanism of effect.

Protein therapy has become very popular, perhaps too popular. Innumerable kinds and varieties of proteins or non-specific agents have been employed, some empirically, others with a definite immunilogical theory underlying their use, and yet all of them, whether it be serum, vaccine, enzyme, or

[1] Read before State Medical Society, Albany, N. Y., April 26, 1922.

chemical agent, having more or less constitutional effect upon the patient. It is now well recognized that three papers published by Renaud, by Kraus and by Ichikawa, reporting undeniable clinical results from non-specific therapy, can no longer be swept aside by the laboratory conception of a strictly specific therapy. This has been made clear by series after series of corroborative observations reported in the European literature from many sources, each independent of the other, different agents and methods being employed, and in the treatment of numerous diseases. These authors are too numerous to mention, but prominent among them are,—Paton, Lilienthal, McCallum, Darier, Bingel and others using diphtheritic antitoxin; Deutschmann, "yeast" serum; Schmidt and Saxl, milk injections; Ludke, proteoses or albumoses; Mittlander, hypertonic salt solution. In America, Miller, Lusk, Snyder and Ramirez have employed typhoid vaccine and secondary proteose in their work and have reported large series of cases so treated.

My observations are limited to those following the injection of diphtheritic antitoxin, although I have employed pasteurized sterile milk in two cases. In the latter (cases of advanced hypopyon keratitis), the constitutional reaction was peculiarly violent and from which no noticeable beneficial effect upon the infection could be traced with any degree of certainty.

On the contrary my experience with anti-diphtheritic serum as a non-specific, or para-specific agent,—whichever it may be correctly considered to be in the light of recent researches,—has proven conclusively to me the efficacy of the serum in combating pneumococcic and staphylococcic infections of the refractive media of the eye. To substantiate this conclusion, I am prepared to offer additional evidence to my previous efforts in the study of this subject. In 1919 I reported thirty cases in detail together with numerous observations by other experimenters, published in the *Transactions of the American Ophthalmological Society*, 1919, and in the ARCHIVES OF OPHTHALMOLOGY, Nov., 1920. Two years ago I reported before this Society in detail fourteen additional cases together with an analysis of the effects and the probable reaction (*New York State Journal*, January, 1921).

During the past two years I have employed the serum in

twenty-three cases; nine of these being hypopyon keratitis, five infection of anterior segment after penetration, three panophthalmitis, six ulcus serpens. To relate these cases in detail would consume unnecessary time, and would only be in fact a restatement, with few exceptions, of similar cases, changes, and results as those presented in my previous reports. A brief analysis of these cases, however, seems fitting, in order to emphasize certain phases of this treatment which may prove interesting and worthy of your own observation.

Of the nine cases of hypopyon keratitis, all but two were past middle life; one of these was twenty-six years of age, the other ten years. In both young patients prompt result from serum injection was observed, and convalescence was short. In only two other cases was delayed effect of the injection noted; one of these, G. W., aged sixty-four, admitted September 16, 1920, proved to have a 4+ Wassermann reaction, but promptly responded with the addition of mercury and K. I.; the other case occurred in a man sixty-five years old with extensive corneal destruction, observed two weeks after the onset, and whose physical condition was extremely poor. This bears out the usual history of these cases, since it is well known that hypopyon keratitis occurs commonly in the aged and among debilitated individuals, frequently following upon the neglect of a local injury. These observations were also noted in the forty-four cases I have previously reported and are in keeping with the two fundamental theories as to the biological alterations which take place in the organism after injection of a so-called non-specific agent,—namely, (1) those that involve cellular stimulation, the "Plasmaactivation" of Weichardt, and (2) those resulting from alterations in the permeability of the cells, studied by Luithlen, by Starkenstein and others, and which represents a diphasic phenomenon.

In only one of the nine cases of hypopyon keratitis was the ulcer located in the margin of the cornea, this case being the one related above of syphilitic involvement. Eight cases therefore had the process of ulceration in the center of the cornea, this being the area least protected by systemic resistance, furthest from the source of nourishment (the blood). This observation is also in line with Weichardt's hypothesis of marked increased cellular activity (glandular, muscular and

leucocytic), and with Starkenstein's diphasic changes in the permeability of the capillaries and tissue cells, which results from moderate doses of non-specific agents, such as anti-diphtheritic serum or typhoid vaccine, etc., and which therefore produces so-called "non-specific" resistance to infection in a vital area (center of the cornea) and in an aged and debilitated individual.

In all the cases in which smears or cultures were made, the pneumococcus, as was to be expected, prevailed.

The treatment was similar in all the cases:—cauterization with carbolic acid (concentrated) followed immediately by alcohol (50%); in advanced cases multiple incisions through the ulcerated area, followed by the carbolic and alcohol cauterization. Anti-diphtheritic serum, from 1000 to 3000 units (varying with the age and size of the patient), was injected at the earliest possible moment, this dose being repeated in 48 hours depending upon the reaction observed after the previous injection, and as often thereafter repeated as seemed advisable in the individual case. The usual local treatment of hot fomentations, atropine and bichloride vaseline (1–5000) was fairly routine in all the cases.

Daily observation of these cases revealed changes most of which I have previously mentioned, but which now are almost to be expected as the course of such a case is followed. In twenty-four to forty-eight hours after the initial injection the hypopyon was reduced or had disappeared in all but one case (this being syphilitic); hypopyon reappeared in two cases but disappeared promptly with the injection of the serum. Besides the very noticeable effect upon hypopyon, almost invariably there was relief of pain, rapidly subsiding conjunctival and iritic reaction, and a clearing away of ulcer débris, such as does not usually occur in these cases, the ulcer itself taking on a clear and clean appearance early in the process of repair. Here again we find our observations are perhaps accounted for, are really expressions of the non-specific reaction to serum injection, conclusions arrived at by investigators in larger fields of research than ours. I refer you especially to the researches of Luithlen in 1912, those of Von den Vekden, Siegert, and Starkenstein relative to the increased permeability of the capillaries and cell membrane; those of Dollken and King

relative to the nervous reaction; also those of Heidenhain, Teague and McWilliam, Davis and Petersen relative to the lymphagogue effect following protein or non-specific injections.

Of the five cases of penetrating wound with infection, only one of them—observed late and in a man 46 years old—resisted the stimulating and generally resisting effect of the serum injection, but even this case subsided without violent local symptoms, the anterior chamber clearing entirely of hypopyon, the cornea becoming clear and lustrous—evidence of the lymphagogue effect?—although phthisis of the globe slowly followed. Another of these cases—girl, H. B., 9 years (Hospital No. 6562), ruptured globe with infection,—improved remarkably after serum injection, and although phthisis followed slowly, the anterior segment of the eye in a short time cleared entirely of hypopyon, the cornea remaining clear and lustrous. In another case—T. O., strong and stalwart man of 43 years (Hospital No. 04431), cornea penetrated by nail three days before, hypopyon *2mm*, violent conjunctival and iritic reaction—definite signs of repair and relief of pain followed the initial injection of 3000 units, hypopyon gradually disappeared, reaction subsided, and he was discharged after 12 injections of the serum, the eye being entirely quiet, the anterior segment clear and lustrous as the normal eye. In another case— F. C., man, 29 years (Hospital No. 7211), penetrating wound of cornea, admitted March 27, 1922, *no* hypopyon; *third* day in spite of the usual intensive local treatment hypopyon *2mm* developed over night, lips of wound were whitish, entire cornea hazy, usual iritic reaction—not *until* hypopyon developed was the serum injected, 3000 units. A peculiarly violent local and constitutional reaction followed (great œdema of the injected arm, temperature 101½, nausea and headache, mild erythema of arm and body), but in 24 hours there was coincident with this general reaction, relief of ocular pain and definite reduction in the hypopyon, which disappeared entirely in 48 hours, and daily improvement (clearing of the anterior segment) allowed his discharge 10 days later. Could this complete reversal in the behavior of an anterior infection be attributed to sudden systemic stimulation ("Omnicellular Plasmaactivation" of Weichardt) and increased local resistance through increased permeability of the capillaries and cellular

elements induced by the protein injection? My answer is, that at least such effects as these, undeniably demonstrated, can not be ignored. It is quite evident that the best opportunity for observation of the clinical effects is offered by cases of penetrating wound of the cornea with infection, because the only local treatment administered is that of hot fomentations and atropine, antiseptics being of little value, whereas in ulcus serpens with hypopyon, the effect of cauterization and local antiseptics can not be as clearly separated in many cases from the effect induced by protein injection.

Of the three cases of panophthalmitis, two occurred following penetration, one after cataract extraction. Would that time permitted to relate these in detail, for in each case there was evidence of local resistance to the infection. Suffice it to say, that in one case the eye slowly quieted, anterior segment cleared entirely, all conjunctival reaction subsided, the eye, now one year old, is soft, of good appearance, and he refuses enucleation. A second case, very similar to the first remains under observation. The third case, observed at the very onset of the infection, received 3000 units, with marked improvement in 24 hours, but subsequent injections failed to check the process, and slowly but quietly, only moderate reaction being present, disintegration of the globe continued. At this time, however, the anterior segment is unusually clear as though irrigated by a lymphagogue effect of some systemic influence (protein?).

Six cases of ulcus serpens are mentioned as being treated with the serum, merely to indicate the character of case best suited for protein therapy. The results are found in these cases. In all but two of them cauterization was used, because the ulcer was almost invariably located centrally, and most frequently in patients past middle life, and to delay local intensive measures, in order to observe the serum effect, would prove little and risk much. Furthermore, under such conditions, where delay was possible and justified, improvement and healing may have occurred anyway, regardless of injection without intensive antiseptic measures. Here the *natural* forces of resistance may have been sufficient without either injection or antiseptic aid.

Aside from my own observations on this subject, I wish to

call your attention to the experience of others who have used anti-diphtheritic serum as an aid in combating ocular infection. Dr. Shober Smith has kindly presented to me the histories of four cases, in which he recently used the serum. Two of these were cases of hypopyon keratitis, in which the hypopyon disappeared in 48 hours after injection, both cases proceeding rapidly to a satisfactory result; one case of penetration with infection of wound and hypopyon (*2mm*) yielded promptly to injection, in 24 hours hypopyon disappeared, all symptoms rapidly subsided; one case of infection after iridectomy in a man 73 years old, hypopyon and cloudy anterior segment second day, serum injected with disappearance of hypopyon in 24 hours, and recovery; later extraction of the lens yielded vision = $\frac{20}{30}$. Dr. F. W. Shine has employed the serum in five cases; one of these a case of hopeless sympathetic ophthalmia and in which in 48 hours there was definite evidence of a clearing of the anterior segment; also a case of infection after cataract extraction, which promptly yielded to treatment and recovery. Another case of post-operative infection in which he was uncertain of any effect; also two cases of ulcer serpens, in one of which no effect could be detected, the other recovered without event. Dr. G. H. Bell has used the injections in a number of cases and believes in the efficacy of the treatment. Dr. Henry L. Sloan, Charlotte, N. C., reports a case of infection after penetration which was definitely improved by diphtheria antitoxin injections. Dr. de Schweinitz reports a case of hypopyon keratitis unaffected by intensive local measures; 30 hours after injection of 1500 units of anti-diphtheritic serum improvement was noted, and the condition subsided after further injections of the serum. At the next meeting of the American Ophthalmological Society, Dr. H. F. Hansell and Dr. G. O. Ring, Philadelphia, will present a paper which concerns itself with the report of four cases of post-operative infection and one case of violent infection following foreign body in vitreous. Each of these cases they believe to have been cured by the administration of diphtheria antitoxin.

NON-SPECIFIC REACTION

During the past five years this subject has received such wide attention, yielding innumerable clinical observations and

intensive experimentation, that correlated data from many sources has begun to focus upon a common ground of understanding as to the reaction of the organism to non-specific therapy and the mechanism of this reaction. This study has grown out of nature's own methods of resistance and repair, constantly demonstrated by the reaction from counter-irritants, vaccines, enzymes, drugs, yeasts, colloidal metals, etc. It is believed, therefore, that in a similar manner there is brought about in the body true tissue stimulation and activation, the therapeutic effect being produced by altering the reactivity of the whole organism, rather than directly influencing the cause of the pathological process.

This reaction is expressed (depending upon the character and amount of the agent injected and the sensitization of the particular individual to it) by a chill, rise in temperature, variations in pulse and blood pressure, sweating, nausea, nervous irritability, skin reaction, glandular activity, permeability of the capillaries, lymphagogue effect, and certain variations in the blood—such as concentration, leucocytic response, increased antiferment, and alteration in the antibody titer of the serum of the patient. Luithlen determined the permeability of the abdominal capillaries by injecting sodium iodid into the veins of rabbits and tested the rate at which it entered into the Ringer's solution which he had injected into the peritoneal cavity. Siegert and also Schmidt found that small doses of protein increased the permeability. Starkenstein produced corneal ulcers in rabbits, then observed the rate at which dyes would diffuse out at the site of the lesion after a variety of non-specific injections. It was concluded that non-specific injections increased the permeability of the capillaries for a short period and later caused a definite lessening of the permeability. Heidenhain classifies certain proteins as lymphagogues because of the marked increase in the lymph flow which they produce. Teague and McWilliam believe the lymphagogue effect is responsible largely for the therapeutic influence of protein injections, because the antibodies of the blood stream are forced into the lymph spaces and there may destroy the invading micro-ŏrganisms. Davis and Petersen investigated this effect upon the lymph flow, using dogs in whom a lymph fistula was made at the thoracic duct and

then injecting killed colon vaccine intravenously to produce the shock effect. It occurs to me that the above related experiments are highly significant when one repeatedly observes the effect of diphtheritic antitoxin upon the lymphatic structures of the eye, the effect upon hypopyon, and clearing of the anterior segment, already alluded to.

Some believe that the chief factor in the therapeutic result is from leucocytic stimulation, but this point is variously regarded, since many conflicting experimental results are reported. Others believe the therapeutic effect is due to some alteration in the antibody titer of the serum of the patient. This theory also is the subject of much debate and of continued experimental tests. The popular explanation is found in the general stimulation of the protoplasm (Weichardt) and in the permeability of the cell membrane (Luithlen and Starkenstein.) Permeability of the capillaries is increased as evidenced in the increased lymph flow and in the concentration of the blood; permeability of the tissue cells is increased, with an outpouring enzymes, immune bodies, etc.; increased permeability of the nerve cells is associated with a lowering of the threshold for nervous impulses and is manifested clinically in increased irritability, headache, and susceptibility to pain. When this first phase has passed a compensatory phase of lessened permeability of the cells occurs, with lessened nervous irritation and susceptibility to pain—lessened exudation—a lowering of enzyme concentration, etc.

With these investigations in mind, I have recently given sub-tenon injections of warm hypertonic salt solution at three to twelve hour intervals after injection of the serum, for the purpose of increasing locally the flow of lymph, increasing the permeability of the capillaries, and stimulating leucocytic activity. Only four cases have been so treated, but the effect noted is worthy of mention, and leads me to believe that with more light upon the subject of administration and dosage in relation to the stage of the infectious process and the time of other treatment, one may administer the serum with more confidence in the effect.

I wish to extend my thanks and appreciation to Dr. W. E. Lambert, on whose service at the New York Eye & Ear Infirmary most of these cases have been studied.

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ILLUSTRATING DR. SANFORD R. GIFFORD'S ARTICLE ON "THE PATHOLOGY OF UVEITIS."

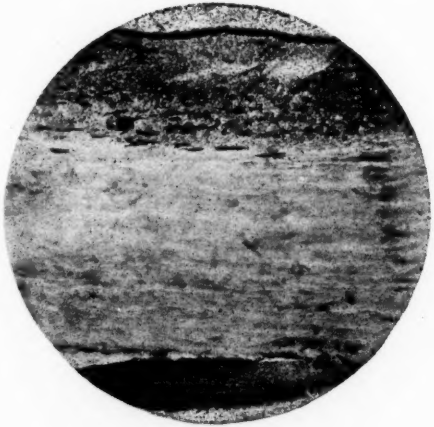

FIG. 1.
Sympathetic ophthalmia. Low power showing diffuse thickening of choroid.

FIG. 2.
Sympathetic ophthalmia. High power.

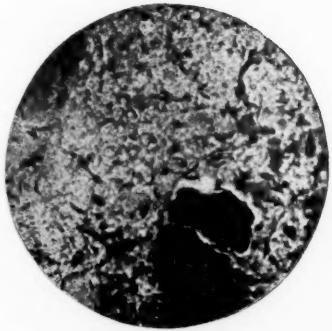

FIG. 3.
Normal guinea-pig. Impression of choroid showing fusiform bodies.

THE PATHOLOGY OF UVEITIS.[1]

By Dr. SANFORD R. GIFFORD, Omaha, Nebraska.

(With three illustrations on Text-Plate XX.)

THIS paper will attempt briefly a review of the events seen clinically in the principal forms of uveitis, in the light of the pathologic processes involved, bringing in histology only where it seems to throw light on these processes. While we are all most interested just now in uveitis due to focal infections, the diagnosis in a case of iritis is not finished when we are informed of a root abscess or an infected pair of tonsils. I have had three cases during the past year which have shown, besides throat, nose or tooth pathology, both a four plus Wassermann and a positive tuberculin test. In such cases, one's clinical judgment often needs all the help that a knowledge of the pathology in question can give it.

SYPHILIS.

The ordinary iritis fibrinosa of syphilis shows no absolutely specific clinical signs, and may show none even in sections. Typically, however, its seat is in the deeper layers of the iris, and this results in lesions different from those of so-called rheumatic iritis which affects chiefly the anterior layers. The whole iris is swollen and œdematous. The exudate in the posterior layers binds them firmly to the lens capsule, so that the synechiæ include not only the pigment layer, but the iris stroma, and these thick bands are seen when the pupil is dilated, forming pointed or tongue-shaped irregularities in the pupil. Due as it is to a peri- and endarteritis, the formation of

[1] Read before the Chicago Ophthalmological Society, April, 1921.

perivascular nodules of round-cell infiltration is characteristic. Though often too small to be seen grossly, specimens removed at iridectomy, as by von Michel, (1) have usually shown their presence about inflamed and even obliterated vessels. When closely searched for, larger nodules are sometimes just perceptible to the loupe, and when found, help materially in the diagnosis. The deposits on Descemet's membrane often show a zone of infiltration around them which may exceptionally extend so deeply as to leave scars interfering with vision. Rarely, spirochætes may be deposited in these areas and set up foci of active infection. By analogy with lesions elsewhere, spirochætes are probably always present in small numbers in the iris nodules. Myashita and Nakamura have recently reported a case of hemorrhagic iritis in which spirochætes were found. A recent report by Rumbaur (2) with pathologic findings, indicates that the iritis of hereditary lues presents a picture different from that in the acquired form, the infiltration affecting the iris stroma and the vessels being almost entirely spared.

This form of iritis is an early secondary manifestation of syphilis. Half of Badal's (3) cases occurred in the first year after infection, a large number in the eighth month, so that it may be considered to correspond with the specific sore throat.

The later forms, papules and gummata, while more definite in their pathology, are not so important for diagnosis and are less often seen. Most pathologists now admit that there is no essential histological difference between the lesions called papules and those called gummata. The principal difference is one of size, the early lesions remaining small and often absorbing without breaking down, while the later ones grow larger, the central vessels are obliterated, and necrosis takes place with caseation and the appearance of giant cells. But all stages between the smallest papule and the largest gumma occur. In a recent series reported by Clapp (4) nodules of both types together occurred in 8% of cases. In a series of Badal, they composed 5%.

In the iris, the early lesions, coming on often at the same time as a papular skin eruption, should properly be called papules. They develop in the deep layers of the iris, nearly always in the region of the sphincter and push up the stroma

till they are seen on the anterior surface through a thinned layer of stroma. They are characteristically round and the longer the interval between the primary lesion and their appearance, the larger and more solid they are apt to be. They usually absorb slowly but may burst into the anterior chamber, due to a breaking down at their centers.

The so-called gummata all appear at the iris-root, and most of them originate in the ciliary body. They form tumors as large as the lens or larger, often filling the anterior chamber and perforating the sclera at the limbus. Scleritic nodules may be formed by direct extension before the growth ever appears in the iris root.

These growths, while occurring later than the papules, are, as a rule, earlier than so-called gummata, arising anywhere else in the body. Hanke's large growth occurred six months after the primary and many others occurred in the presence of a papular rash. The term condyloma, which I notice Clapp uses in his article, should imply granulation tissue on a moist mucous or epithelial surface and I believe should not be applied to iris lesions.

In the choroid, nodules which may be called papules, or more usually gummata, occur; usually somewhat later than in the iris. The commoner diffuse luetic choroiditis is an early secondary sign and analogous to diffuse iritis. Though no nodules may be seen clinically, the œdema and inflammation of the choroid is due to the formation of numerous very small peri-vascular nodules of infiltrate, and it is at the site of these that the lamina vitrea is broken through, the pigment layer is involved, the retina is bound down to the choroid by exudate and proliferation of the pigment layer occurs, resulting in the black spots seen when the exudate has absorbed. Where the nodules are larger, defects in the pigment epithelium are left and the pigment cells at the border proliferate to form the black rim of the resulting white spot. The different fundus pictures produced by syphilitic choroiditis, acquired and hereditary, seem to depend on the site of the exudate and its distribution in larger or smaller nodules. About 9.5% of disseminated choroiditis is due to syphilis, and the few cases examined microscopically show no essential difference from that due to other causes. Sidler-Huguenin (5) has suggested

an interesting classification of the types of choroiditis occurring in hereditary lues, but purely on a clinical basis.

TUBERCULOSIS.

Diffuse iritis corresponding to that of lues is probably one of the rarest ocular manifestations of tuberculosis. Usually nodules occur which are small tubercles, but their site is often in the deeper layers, so that they cannot be seen clinically. The exudate in the deep layers causes dense adhesions to the lens capsule, so that the synechia, as in luetic iritis, involve the iris stroma. Sections usually show very small tubercles and the bacilli may be found in these in a fair number of cases. The exudate thrown out, though it may cover the pupil, is poor in cells and fibrin, and seldom leads to seclusic pupillæ, though I have seen this occur.

So-called serous iritis is not uncommon, where precipitates on Descemet's may be the only clinical sign; and indicate an involvement of the ciliary body, usually with formation of tubercles. The precipitates may carry tubercle bacilli, and Krückmann (6) describes the formation of tubercles with giant-cells on Descemet's. The larger tubercles of the iris need little remark. They are typically white or grayish, and millet-seed in size. In contra-distinction to luetic papules, they may occur in any part of the iris, and usually several are seen at once in different parts. Larger conglomerate tubercles more rarely occur, and on breaking down, form masses of tubercular granulation tissue in the anterior chamber.

Both tubercular and luetic nodules, when they are absorbed, leave atrophic defects in the iris stroma through which the pigment epithelium is seen.

In the choroid, besides appearing in about 35% of miliary tuberculosis, single or multiple tubercles are seen in other forms of tuberculosis. Their pathology is that of tubercles elsewhere. The exudate on their surfaces may cause detachment of the retina or adhesions may occur with involvement of the retina. When these break down, masses of tuberculous granulation tissue may form pseudo-tumors in the vitreous.

A certain number of cases of disseminated choroiditis are of tuberculous origin, as Stock (7) has proved, but their pathology so far as it has been worked out, shows nothing specific.

SYMPATHETIC UVEITIS.

Though the pathologic changes in Sympathetic Ophthalmia, mono-nuclear infiltration with the occurrence of giant cells and epitheloid cells, are well-known to most clinicians, there is still some dispute as to whether this picture is pathognomonic of S. O. Gradle (8) has reported such changes in eyes removed for traumatic irido-cyclitis when the other eye showed no signs of inflammation, and it is of some importance to know whether similar changes may occur in any case of traumatic irido-cyclitis or whether these eyes were potentially sympathogenic, and would have caused S. O. if they had been left. There is no doubt that the original polymorpho-nuclear reaction following trauma by an infected foreign body is later more or less replaced by mono-nuclears if the infection continues active in a sub-acute or chronic form. Large mono-nuclears and even giant-cells are known to occur in such chronic infections, in the eye as well as elsewhere. But it is surprising how many eyes which have remained irritable for several months or longer after the wound, show on section almost no cellular reaction at all; only a scarred choroid with proliferation of pigment cells, and a fibrinous exudate near the site of the wound from which most of the cells have disappeared. Where some cellular infiltrate is left, it is usually confined to several points, at the site of the wound, around Schlemm's canal, and around the perforating ciliary vessels.

In the eyes that I have examined (about six in number) which were removed on account of definite sympathetic inflammation in the second eye, the cellular infiltrate involved nearly the whole uveal tract. Nodules of round cells were found all through the choroid and iris; the round cells of the choroid were much increased in number, and often the whole choroid was two to four times its normal thickness, being a solid mass of large and small mono-nuclear infiltrate. (Figs. 1 and 2.)

Though caseation has been described, I have never, in these masses, seen any indication of a breaking down process. There seems to be an active proliferation which produces a picture resembling, in some cases, a new growth.

Giant cells I have not found very frequently, in fact, perfectly definite giant cells were very hard to find in my sections.

The characteristic thing to me seems to be the involvement of the whole uveal tract in the cellular reaction with the absence of a tendency to break down.

In view of Ichikawa's (9) report last year of finding in sections of S. O. peculiar fusiform bodies which he considered characteristic of S. O., possibly fusiform bacilli and possibly crystals, it seems worth reporting an accident which occurred to me. On making smears of the vitreous and choroid of a guinea-pig which I had injected with a fusiform bacillus, many fusiform bodies were found and since fusiform bacilli were grown in pure culture from the vitreous, the bodies were considered bacilli. Later, however, in similar smears from a guinea-pig's eye injected with an entirely different organism, the same bodies were seen. A normal eye, when the membranes were pressed down on the slide so that the choroid was traumatized, showed them in large numbers. I was unable to stain them by the technique described by Ichikawa, but considered them pigment crystals. I have not seen them in human sections, but their resemblance to Ichikawa's bodies is at least interesting. (See Fig. 3.)

FOCAL INFECTION.

The cases of uveitis which we now know are due to focal infection conform typically to the rheumatic uveitis of the older writers. In the iris they affect principally the anterior layers, which are swollen and œdematous with fibrinous fluid. The anterior endothelium is raised in places and where it breaks down deposits of fibrin are seen on its surface. In cases that remain long untreated, the anterior chamber is filled with a fibrinous fluid, in which are a few leucocytes. The bands of fibrin become attached to the corneal endothelium and according to Krückmann, it is these fibrinous attachments which cause many of the fine spots seen on Descemet's.

When the pupil is dilated, the central bands of fibrin are drawn upon and broken from their attachments. Then the posterior synechia are revealed, where the exudate has been in contact with the lens capsule. These synechiæ usually affect only the posterior pigment epithelium, which is torn loose, leaving rounded brown indentations of the pupil, and

these brown synechiæ, in which no iris-stroma is included, help to distinguish the case from one of the deeper forms of iritis.

In the acute form, no gross nodules are formed, but in chronic cases the spots of localized œdema in the iris become confluent and deeper infiltration may occur. When the cause is removed the œdema absorbs, and aside from the synechiæ, little or no atrophic changes are seen in the iris.

The gonorrheal cases are properly to be included in this group and typically differ little from the "rheumatic" forms. They run a more chronic course, but rarely affect severely the ciliary body and almost never the choroid. Some writers believe that the appearance of a hypopyon-like exudate in the early stage which is soon absorbed is suggestive of a gonorrheal origin.

In the so-called rheumatic forms the ciliary body is often affected and indeed it is questionable if in every case of diffuse iritis some cyclitis is not always present. Fuchs has shown that the deposits on Descemet's originate chiefly in the ciliary body, as masses of similar lymphocytes are found on the bands of the zonula and the cells on the cornea often contain uveal pigment. They lie in small clumps on an intact endothelium which may later break down by long contact. Descemet's membrane, however, is seldom if ever broken down, so that for this type, the term Descemetitis is entirely misleading. Snellen, Jr. (quoted by Parsons, 10) found bacteria in these clumps of cells, but they are not usually present. The larger clumps often show hyaline degeneration forming what the English call "Mutton-fat keratitis punctata."

The choroiditis due to focal infections may be of various types, and is hard to distinguish from other forms, especially from luetic choroiditis. Even the microscopic anatomy is rather similar to diffuse forms of the latter condition, the basis of both being peri-vascular round cell infiltration. Here, too, the later changes most commonly seen, are due to degeneration of the pigment epithelium, consequent to a breaking down of the lamina vitrea or to the filtration of toxins through it, with resulting absence of pigment over certain areas and heaping up of pigment cells at others. Pigment granules freed from broken down cells are also taken up by leucocytes and carried

into the retina or superficial layers of the choroid, producing the fine pepper and salt appearance sometimes seen.

These rheumatic cases are naturally seldom investigated anatomically or bacteriologically. The lesions produced in animals by Rosenow (11) and by Brown, Irons, and Nadler, (12) are comparable, however, and in them streptococci are found in the iris. On account of the production of a septicæmia, their lesions were much more severe than are seen in ordinary cases due to focal infection, and the same may be said of those produced by von Michel with silver nitrate.

The old idea that these cases are caused by absorption of toxins is probably, in most cases, erroneous.

Since the organisms in question, chiefly streptococci, but also staphylococci, pneumococci and gonococci, produce only endotoxins which could reach the eye only in very small quantities, it is probable that almost all these cases are really metastatic, originating in bacterial emboli, of living virulent organisms in the severe cases, and of dead or attenuated ones in the milder cases. Metastatic uveitis usually implies the severe acute inflammations with pus formation occurring in pneumonia, influenza, or other septicæmias, which usually end in panophthalmitis. In this connection, Benedict's (13) recent report is of interest, showing that severe irido-cyclitis may be produced fairly often by injections of certain strains of bacteria into the blood stream of animals. In a personal communication he states that purulent panophthalmitis was never produced by these injections.

Purulent iritis and choroiditis are seen in similar conditions where the exudate and infiltrate on the iris and in the iris and choroid is frankly purulent; but which heal by extensive connective tissue formation without the picture of panophthalmitis. It is probable, however, that all stages may be seen between these massive metastases of virulent organisms, and the smaller ones occurring in focal conditions, where only a few organisms find their way into the blood stream at any one time.

SUMMARY.

While all types have numerous exceptions, the typical cases show, according to their etiology, certain pathologic differences which may often be made out clinically.

1. The cases due to focal infection show an affection of the anterior layers of the iris with synechiæ involving only the pigment epithelium, and seldom show any formation of nodular infiltrates.

2. Cases due to lues and tuberculosis show lesions of the deeper layers with broad synechiæ including iris-stroma. Nodule formation occurs in most cases, in many of which it can be seen clinically. The larger nodules of each disease are usually clinically distinct and cases of tubercular uveitis without demonstrable tubercles are relatively rare.

3. Sympathetic ophthalmia is characterized by a diffuse mono-nuclear infiltration of almost the whole uveal tract which may often be made out clinically, especially where the fundus can be seen.

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REPORT OF THE PROCEEDINGS OF THE SECTION ON OPHTHALMOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. BEN WITT KEY, Secretary.

MEETING OF MARCH 20, 1922. DR. J. M. WHEELER, CHAIRMAN.

A case of **voluntary tremor of the eyeballs** was presented by Dr. Julius Wolff.

K., aged 12 years, a deaf-mute, with normal vision, stated that her eyes often shook when she had to use them. On close examination the eyes suddenly began to make very rapid horizontal motions back and forth, the excursions being about 4*mm*. The movements did not resemble the slower, oscillating movements of nystagmus but could be described as a rapid, horizontal tremor, occasionally a rotary motion being added. The patient has these movements completely under voluntary control and is able to start or stop them on command. She can elicit the same movements, but to a much less degree, when the eyes are turned to either side or raised or lowered.

Dr. Wolff said he explains this induced tremor by assuming that the patient simultaneously innervates all antagonists concerned in horizontal movements and thereby produces a tremor analogous to that which any one can induce in the hand by holding the forearm very rigid. He had observed the child on several occasions and the result was always the same. He believed that the tremor does not represent a pathological condition but merely an unusual control over the eye-muscles.

Dr. T. H. Curtin read the history of a case of **tumor of the hypophysis:** A. C. R., aged 41 years, weighing 238 pounds, acromegalic in appearance, complained of blurred vision, metamorphopsia, general malaise and dizziness. Right eye

= $\frac{3}{100}$; left eye = fingers at one foot; pupils react normally, fields normal. Double choked disk, 5–6 dioptres; hemorrhages in macular region. X-ray showed "enlarged sella; clinoids eroded; sella apparently rests within sphenoidal sinus."

Dr. CLYDE E. MCDANNALD reported a case of **bilateral papillœdema due to tumor of cerebellum, post-operative.**

Man, aged 37 years, complained of headache 18 months before. The pain was dull and constant in the upper part and back of his head radiating down his back, always more severe in the morning. Occasional paroxysms of pain would prostrate him and he would become bathed in perspiration. There was no nausea or vomiting.

Vision, O. D. $\frac{3}{60}$; O. S. $\frac{3}{60}$ unimproved with glasses; muscle balance unaltered; pupils equal in size and normal in reaction; nerve-heads elevated, red and œdematous; right fundus showed retinal hemorrhages and albescent spots resembling somewhat those in albuminuric retinitis. Fields were not altered; no scotoma or enlargement of the blind spots. Reflexes were normal. X-ray, urinalysis, blood and spinal Wassermanns were all negative. Diagnosis: tumor in the posterior fossa, and patient referred to Neurological Institute.

On March 3, 1922, after operation, vision O. D. $\frac{3}{100}$; O. S. $\frac{3}{60}$. Right showed a receding neuritis with absorbing retinal hemorrhages; albescent spots remained, arteries fairly thin. Left eye showed receding neuritis, no hemorrhages, two small spots nasalward. March 16, 1922, O. D. $\frac{3}{60}$; O. S. $\frac{3}{24}$.

Report of the operation was as follows: "A sub-occipital craniotomy was performed on January 17th, exposing a large tumor *12cm* by *8cm* having its origin from the sub-tentorial surface of the dura. It extended downward, pushing the cerebellum before it and extending on the vermis. Diagnosis: Endothelioma."

A **symposium** on the **value** of the **Wassermann test** was the subject of papers by the following authors from the viewpoint of their special branches of medical study.

Dr. C. G. DARLINGTON, from the **serologist's** point of view, first explained the meaning of the term 4 plus Wassermann and the value of the quantitative Wassermann, and pointed out that the method and time of fixation as well as the antigen used must be known to the physician in order to properly interpret

Wassermann reports. For example a fifty-minute heat fixation with cholesterin antigen and a four-hour ice box fixation with plain alcoholic antigen would give more nearly equal results.

Referring to Wassermann reactions in children he stated, as result of a study of 1000 consecutive cases, that cholesterin antigen in children seems to be less reliable than in adults (gives more non-specific fixations, and autopsies on children with 4 plus cholesterin findings showed no evidence of lues).

Regarding the Wassermann test in diseases of central nervous system, after a study and analysis of the first routine 10,000 specimens during the past year at Bellevue Hospital, he concluded that all the positive results were apparently from cases of nervous disorders. Furthermore, it seemed that neural changes in syphilis are often overlooked, which should and could be recognized, were more and earlier lumbar punctures made.

He numerated leprosy, yaws and trypanosomiasis as that group of diseases in which there is no doubt but that the disease in question gives a positive Wassermann per se. In a second group (in which at various times a positive test has been reported as occurring) he placed the following: pneumonia, diabetes, lead poisoning, malaria, typhus, liver conditions, occasionally after ether and chloroform, uremia, pregnancy, relapsing fever, scarlet fever, brain and cord tumors, thyrogenous psychosis, tuberculosis, Vincent's angina, and pellagra.

Concerning the Wassermann test in ocular disease, his study of some 33,000 Wassermann records, 207 satisfactory results were reported. Analysis of these led him to conclude that plain alcohol four hour ice and cholesterin 50 minute heat have nearly equal value. A slightly higher percentage of positives were obtained with cholesterin and heat. He emphasized that cholesterin antigen has its primary place as an index of treatment rather than of diagnosis. From the view point of diagnosis, however, the cases studied had shown the following percentage of positive Wassermann tests: 45% in optic atrophy, 41% in keratitis, 23% in iritis.

Dr. J. A. Fordyce, from the **syphilologist's** point of view, stated that, since the Wassermann reaction had been sup-

plemented by spinal fluid examinations a new view point had been given us as to the pathological conditions which cause the various eye muscle paralyses that so frequently precede some of the serious types of neurosyphilis. Instead of the vague expression "nuclear affection" or degeneration which was formerly in vogue as an explanation we now find positive phases in the fluid which indicate involvement of the meninges. A negative Wassermann reaction may occur in certain focal eye lesions where the complement fixation substance is insufficient or where it does not gain access to the blood stream. In early syphilitic disease of the deep vessels of the eye of a progressive character he has exceptionally found the reaction negative. In such cases active treatment is indicated and may favorably influence the vascular disease. In late vascular syphilis of the eye with a previous history of hemiplegia progressive disease of the chorioretinal vessels may be found with a negative blood and fluid. The vessel degeneration progresses in certain of these cases and may or may not be caused by active spirochætæ. Damaged blood vessels with progressive thrombosis offer a possible explanation for therapeutic failures.

In optic atrophy the information gained by examination of the spinal fluid is of inestimable value if properly interpreted and followed by logical treatment. In some of these patients he has been able with the coöperation of his colleagues to follow the changes in the eye grounds over a period of years and to correlate them with the findings in the spinal fluid. In the majority of cases of optic atrophy all phases are positive. A high cell count with a strongly positive reaction, indicating a meningitis about the optic tracts, offer the patient a much more favorable prognosis than a negative or a weakly positive reaction and a low cell count. In the one case we have a definite active pathological condition to treat and in the other a degenerative or end process. It is inexcusable to ignore the spinal fluid findings in optic atrophy as in no other way can an accurate insight be obtained as to what is actually taking place in and about the nerve. Actual destruction of nerve fibers can not be remedied but the organisms causing further invasion and degeneration can often be reached by our remedies and destroyed. In optic atrophy the prognosis as to

possible arrest of the degeneration can be based with a fair degree of certainty on the findings in the spinal fluid. Furthermore permanent arrest of the atrophy coincides in the majority of cases with progressive improvement in the spinal fluid findings.

The value of a positive Wassermann reaction in the blood and spinal fluid as an aid to the clinician in diagnosis and treatment is greater than the value of a negative reaction in excluding a syphilitic condition. The reaction is weakest on the negative side. It has its value in excluding syphilis in types of optic neuritis due to focal infection, in relapsing iritis in late syphilis where other causes than the luetic infection can be evoked and in tuberculous disease of the deep parts of the eye which closely simulates a syphilitic process.

Experimental work with strains of spirochætæ shows that organisms recovered from the central nervous system have a special predilection for the eye of the rabbit. Because of this work we have endeavored to ascertain the types of eye syphilis which show nervous system involvement. The majority of our cases of congenital and acquired keratitis have negative spinal fluids. Iritis is usually unaccompanied by fluid changes.

Dr. WARREN COLEMAN, from the viewpoint of the **internist,** said that the Wassermann reaction illustrates perhaps better than any other diagnostic laboratory procedure the pitfalls which beset the man, whether he be serologist or clinician, who fails constantly to keep in mind the fact that the diagnosis of disease rests upon the proper analysis, and grouping, of the phenomena which every disease exhibits, and that there are few diseases in which characteristic symptoms are always present and special tests always positive. Accepting this point of view, it is permissible, almost to regret the development of a new diagnostic test. Diagnostic tests are fertile breeders of carelessness in the study of a patient and his history and the greater the enthusiasm which greets the announcement of a new test, the greater is the danger that it will have this effect. In making hospital rounds, for example, it is so easy to say "have such a test made and we'll make the diagnosis to-morrow" instead of spending the half hour or so required for thorough study of the patient.

As the result of his experience, he has come gradually to

regard it with greater skepticism than any other special test. The Wassermann reaction is not a specific reaction, it is only a special test. Its full significance, and especially its limitations, are not yet known. This is also true even of some specific reactions: certain features of the Widal reaction, for example, being still in dispute. The Wassermann reaction is obtained more constantly in syphilis than in any other disease but is not confined to syphilis. In some typical cases of syphilis the Wassermann reaction is negative, at least for a time. In Bellevue Hospital, Symmers found the reaction had been negative in from 31 to 56% (depending on the antigen) of a series of cases which showed characteristic anatomical lesions at autopsy. Further than this, the reaction may remain strongly positive in patients who clinically have been cured of syphilis by intensive treatment with arsenic, mercury and the iodides. And fatal explosions of cerebrospinal syphilis may occur in persons whose blood Wassermann is negative. The significance of these facts can not be ignored.

In syphilis, as in every other disease, it is hazardous to risk a diagnosis on a single symptom, or physical sign, or even a laboratory test.

Dr. R. E. Pou, from the **neurologist's** point of view, stated that there was very obvious confusion in regard to the Wassermann reaction which leaves the clinician somewhat at sea. On the one hand, in primary and secondary syphilis some observers find evidence of syphilis in eighty per cent., while others contend that thirty per cent. is nearer the truth. This "septicæmia" is usually transitory. Its persistence after the third year is held by Ravaut (quoted by Kaliski) to be evidence of involvement of the central nervous system.

On the other hand, it is well known that many distinct phases of syphilis present no positive findings. Among these, for example, are vascular neuro-syphilis in young people, some cases of gummata without accompanying meningitis, and certain luetic psychoses, besides occasional cases of tabes, syphilitic epilepsies and spinal involvement of the Erb type. H. C. Solomon has recently made the startling statement that in a given case the results of examination of the spinal fluid from the ventricle, cysterna magna, base of the brain and lumbar sac may differ as to cell count, globulin content, and

the Wassermann reaction. In the light of what we know it is clearly our duty to avoid leaning too heavily upon the laboratory in our diagnosis of neuro-syphilis and to depend more generally upon clinical signs.

From the viewpoint of the **ophthalmologist,** Dr. E. M. ALGER said that the value of the positive Wassermann in ocular disease falls far short of the positive tuberculin test for very obvious reasons, especially because the former shows nothing definite about the eye or the lesion in the eye, although with few negligible exceptions it shows with much certainty that the patient is syphilitic. When the ocular lesion is typically syphilitic (interstitial keratitis) it is confirmatory; when the lesion is doubtfully syphilitic (plastic iritis) it does not by any means settle the question.

The negative Wassermann theoretically ought to be the most valuable of diagnostic tests. Practically it is almost useless, by common agreement. A single negative Wassermann means absolutely nothing. To prove anything, it requires not only several negative blood Wassermann's but also several spinal fluid negatives. Obviously this course can not be a routine, but must be reserved for cases in which there is strong suspicion which can not be cleared up otherwise.

In conclusion he believes the Wassermann test to be an extremely valuable one, but with very definite limitations. It is a test whose value will vary with the serologist who makes it and with its agreement or disagreement with other clinical manifestations of disease. Its interpretation requires intelligence and discrimination, and the worst indictment against it is that it has like other laboratory tests often served as a mental anæsthetic and weakened the intensity of our clinical observation.

Dr. H. W. WOOTTON stated that the symptomatology of syphilitic eye diseases had been so carefully studied before the discovery of the Wassermann reaction that its advent found little to be determined. He doubted whether there was a single important type, certainly none influenced by anti-syphilitic treatment, in which the Wassermann reaction had caused a radical change in our knowledge of the ætiology. It was pleasant to have the agreement of the Wassermann but nevertheless, so far as he was concerned, a violent plastic iritis,

a paralysis of an ocular muscle, choroiditis with opacities at the posterior pole, an interstitial keratitis with the so-called "salmon patch" would all receive anti-luetic treatment whether the Wassermann was positive or negative. In some of the deeper affections of the uveal tract in aiding in the differentiation of syphilis and tuberculosis, he thought that the Wassermann reaction was sometimes of real diagnostic value, but, in general, he regarded it simply as an interesting symptom of syphilis, one not always reliable unless strongly positive and certainly, in hardly any syphilitic eye disease, the most important.

DISCUSSION: Dr. M. J. SCHOENBERG regarded the value of the Wassermann test as dependent upon two points:

1st. How much information is gained as to whether the patient is syphilitic.

2nd. How can it tell us whether the lesion we are dealing with is syphilitic in cases with 4+ Wassermann.

He believes the first point is generally and definitely accepted, but on the second point he thinks the positive reaction does not help the diagnosis in this group of cases, and that one of the most important problems is to recognize non-syphilitic lesions in syphilitic patients.

MEETING OF APRIL 17, 1922. DR. J. M. WHEELER, CHAIRMAN.

The first paper of the evening, entitled **The Filtering Scar,** was presented by Colonel R. H. ELLIOT, of London and is published in full in this issue.

DISCUSSION: Dr. JOHN E. WEEKS spoke of the point of safety from infection. Should one make a thin conjunctival flap that extends well on to the cornea as in the Elliot operation, or should one make a thick flap which does not extend on to the cornea as in the Lagrange operation? He referred to two cases of late infection in his experience with the Elliot operation, the number of cases being about sixty, where the vesicle had become infected through rupture and the eye lost. The question seems to be, shall we make a scleral fistula or a sclerocorneal fistula. In 450 Lagrange operations he had seen no secondary infections.

Dr. ARNOLD KNAPP said that Colonel Elliot had touched

upon a very important point in the fistulization operation, viz., that the dissection should be clean and done with a minimum of trauma. It was reasonable that the less the epibulbar tissues are interfered with the better they will drain. He was interested in Col. Elliot's observation that closure of the fistulous tract may result from a toxic condition of health on the part of the patient. He had recently observed a case which bore out this relation.

The important question in these fistulization operations is the subsequent safety of the eye. Col. Elliot believes that this can be accomplished by the proper fashioning of the flap, but it is not unusual to find the greatest variations in the amount of subconjunctival tissue, and try as hard as one can to get a thick flap, a vesicular, bleb-like conjunctiva results. He asked Col. Elliot to tell us what, in his opinion, are the pathological factors which lead to this condition and what had best be done after it has occurred.

Dr. H. W. WOOTTON stated that, as a rule, he thought, most operators now made their flaps large and thick and for this reason perhaps, vesicular cicatrices were not so often seen as formerly. He had had two late infections. One occurred two years after trephining for buphthalmus and in this case, of necessity, the conjunctival flap had been thin. The second took place about one year after trephining for simple glaucoma and, unfortunately, in the eye in which the patient had the better vision. In the future he would pay particular attention to having the trephine aperture free throughout its whole extent, the importance of which Col. Elliot had so carefully emphasized.

Dr. J. GRAY CLEGG referred to the importance of cleaning the trephine opening of iris tissue and other debris in order to insure proper filtration. He emphasized also the importance of knowing the general condition of the patient. In 500 trephine operations he had experienced two or three infections, therefore he felt that a thick conjunctival flap to avoid vesticulation was essential.

Dr. W. E. LAMBERT asked in what class of cases is the trephine contra-indicated? He had seen one late infection one year after operation, but treatment had averted disaster.

Colonel ELLIOT in reply to the discussion stated that it was

not difficult to get a thick corneal portion of the scar, for the cornea can be readily split in order to place the trephine opening in the proper position.

He ventured to suggest that late infection follows any filtering scar after any operation. Frequently a filtering trephine scar goes through acute conjunctivitis without infection of the globe. He now sees fewer vesicular scars because he makes the conjunctival flap as thick as possible.

He does the trephine in all cases except secondary glaucoma after cataract extraction and where vitreous is present in the anterior chamber (dislocated lens).

Dr. E. GALLEMAERTS (Brussels), presented the subject, **Microscopic Examination of the Living Eye.** He illustrated the way in which he used the slit lamp, and showed lantern slide demonstrations of his studies.

DISCUSSION: Dr. A. GULLSTRAND congratulated Dr. Gallemaerts upon the difficult and elaborate work he had accomplished.

Dr. Gullstrand pointed out the importance of examination of the anterior segment of the eye under magnification, and referred to the binocular magnifier which he had perfected by adapting the instrument to the particular individual. The instrument has a field diameter of 50*mm*, and can be used at a distance of 25*cm*. Where the operator is ametropic, the focusing pieces are fitted into his particular refractive correction, thereby giving satisfaction for distance as well as making minutely clear details at 25*cm*. He also spoke of the multifocal lens, and stated that where the difference in focus was 1½ D., it required sometimes two months before one becomes accustomed to it, but then they were found to be quite satisfactory.

The English translation of Dr. I. BARRAQUER'S paper, entitled **Phakœrisis—Its Advantages and Important Details of Technique** was read by Dr. JOHN O. MCREYNOLDS of Dallas, Texas. This paper is published in full in this issue.

DISCUSSION: Dr. ARNOLD KNAPP stated that extraction in the capsule is undoubtedly the ideal operation which will be universally adopted as soon as a safe method of dislocating the lens in all cases is discovered. Those who were fortunate enough to see Dr. Barraquer operate during the past week

must have been impressed with his dexterity and his success in extracting the cataract in the capsule, and it would seem that this method had solved the problem before us.

If Dr. Barraquer's procedure proves a safe method to dislocate the cataractous lens, the inventor has contributed an epoch-making chapter to the history of cataract operation.

Dr. C. E. McDANNALD complimented Dr. Barraquer upon the success of his method, and spoke of the ideal result where conditions are best suited for the operation.

Dr. W. E. LAMBERT congratulated Dr. Barraquer upon his skill as an operator, and referred to Dr. V. H. Hulen of California who had devised a similar instrument and method of extraction, with some success.

Dr. Lambert spoke of the generally good results from the five cases recently operated upon at his clinic in which he was pleased to assist Dr. Barraquer in the demonstration of his method.

Dr. J. O. McREYNOLDS stated that the discussion of this paper involves not only the particular method employed by Dr. Barraquer but incidentally it touches the entire subject of intracapsular removal of the lens.

In order to obtain a wide range of opinion he had recently sent out to about five-hundred leading ophthalmic surgeons two questionnaires embracing thirty items of inquiry. The responses to these questions combined with impressions gained from his own experience and observation with the Barraquer method as well as the Smith method and still other methods that are found in ophthalmic literature, have led him to conclude that the overwhelming proportion of American Ophthalmologists would prefer to have the lens removed in its capsule provided this did not involve any increase in the hazard of the operation. However, they feel that their opportunities for extensive work in cataract would not justify them in abandoning an operation that had been reasonably satisfactory in their hands for another with which they have not had adequate experience. And they are not likely to adopt any method that cannot be established as an improvement in the matter of safety although some operators of wider experience may attain superior success by a modification of the prevailing procedure.

An analysis of the entire subject would seem to indicate the following features:

If a cataract is removed smoothly in its capsule without undue disturbance of the vitreous, with an accurate adjustment of the pillars of the coloboma if an iridectomy has been made, with an adequate conjunctival flap which may or may not be sutured or left uncut as a bridge, the probabilities are that the patient will secure the maximum amount of visual acuity and comfort, and the minimum amount of reaction and detention from his usual avocation. But we must admit that all forms of intracapsular operations are technically more difficult and that there is likely to be more cases of vitreous loss than by the capsulotomy method. However, whatever complications may occur are almost sure to occur on the operating table while the patient is under control, and vitreous loss with the lens out in its capsule is a much simpler situation than vitreous loss in the presence of retained capsule and cortex.

Dr. J. GRAY CLEGG (Newcastle) said he had seen many of these operations in London as well as those of Dr. Barraquer, and that undoubtedly "it is the last word" so far as complete cataract extraction is concerned.

Dr. I. BARRAQUER in reply to the discussion stated that, while he finds it to be the ideal operation, he wishes to remind all that it is most difficult and not wholly satisfactory to operate as he has been compelled to do recently under strange conditions, upon strange patients (foreign to him), some of them not carefully studied before operation, others even of complicated cataract.

MEETING OF MAY 15, 1922. DR. J. M. WHEELER, CHAIRMAN.

Dr. ALEXANDER DUANE demonstrated in some detail **a simple clinical test for light sense** (Percival), and showed a small hand motor suitable for making the test.

DISCUSSION: Dr. CHARLES STEVENS asked if the test depended upon a certain rapidity of the revolution of the motor. Dr. Duane stated that the test was best made when the revolution is not too rapid.

Dr. JOHN GUTTMAN inquired if it could be used as a color test. Dr. Duane replied that its purpose was to test light sense.

Dr. JOHN E. VIRDEN asked what distance from the eye the instrument should be placed. He replied that it should be placed so that there appears no flashing reflexes on the color object.

Dr. ALEXANDER DUANE also presented **a new table showing accommodation at all ages.** The table demonstrated the maximum and minimum limits as well as the mean range of monocular accommodation at all ages, based on examinations made on 4200 eyes. As an addendum it contains a note on the comparison between the monocular and the binocular accommodation, deduced from a study of 500 cases.

DISCUSSION: Dr. SINCLAIR TOUSEY asked if Dr. Duane had had occasion to note, in his studies on accommodation, what effect repeated X-ray exposure may have upon the accommodation. This had occurred to him because in his own case he seemed no longer to have any accommodation whatever and could not account for it otherwise.

Dr. Duane had made no observation of this kind.

Dr. LEWIS CRIGLER read a paper entitled **a simple operation for pterygium,** and presented two drawings to demonstrate the character of the operation.

Dr. ARNOLD KNAPP presented a patient who had been operated upon in 1914 for **primary tumor of the optic nerve,** with preservation of the eyeball (reported in the ARCHIVES OF OPHTHALMOLOGY, 1915).

To-day the eye appears like a normal eye. Motility is normal. There is no protrusion or any indication of an orbital return, nor are there any indications of an intracranial process. The eye-ground of the other eye is normal.

The case is of interest as showing the benignancy of these primary tumors of the optic nerve, as in this case the process at operation seemed to extend within the optic nerve sheath beyond the apex of the orbit. There are now no evidences of a further growth.

Dr. ARNOLD KNAPP presented the post-mortem findings from the **autopsy** in he **case of a child with glioma of the retina of both eyes.** The metastases involved the periosteum

of the external surface of the skull; the external surface of the dura; the thoracic side of all of the ribs with the exception of two; there were some nodules in the liver and a large gliomatous mass occupied the region of the optic thalamus, a direct extension along one optic nerve, which was enlarged. A ull report will be published.

DISCUSSION: Dr. J. M. WHEELER asked if the central artery of the retina had been resected. Dr. Knapp replied in the affirmative.

Dr. G. W. JEAN stated that since glioma is bilateral in twenty-five per cent. of cases, the fundus of the fellow eye should be thoroughly examined. He believes that evisceration of the orbit will some day be the primary operation of choice in these cases, in view of the frequency of recurrence. Furthermore, it seems advisable that at the same time a brain surgeon also should attack these cases from within the brain, which they can do with reasonable safety.

Dr. KNAPP remarked upon the interest which the case presented, that autopsy of these cases is rare; Dr. Ewing, who performed this one, had never before done an autopsy on a case of glioma of the retina.

Dr. W. B. WEIDLER reported a case of **solid œdema of the face and eyelids.** Miss V. G., aged 20, Spanish. Family history negative. Measles at five years of age, followed by keratitis which was treated over a period of years. Seven years ago she had an attack of what was diagnosed as facial erysipelas, and since then has had recurrent attacks. She has had trouble with her nose, extending over a long period of years, even before the first attack of erysipelas. The swelling of the cheeks and eyelids which followed the first attack of erysipelas, and which has gradually increased, has at no time entirely disappeared.

March 31, 1922. Examination: Pupils, accommodation, convergence, and tension were normal. Both cornea were more or less densely opaque, due to keratitis at five years of age. Vision O. U. = counts fingers at 8 feet. Peculiar swelling of the cheeks and upper and lower lids to pronounced degree. Skin had a normal color and the texture unchanged. The swelling gave a sensation of hardness, but no pitting on pressure, more marked in the upper and lower lids, and which

has the appearance of a blepharochalasis, but blepharochalasis, as is known, only affects the upper lids. A dense scar tissue formation in front of the right ear suggests a keloid. Behind the left ear, over the mastoid, several keloid-like scars together with a swelling, bluish-red in color, appear to be filled with cheesy material. Patient said she had had a number of these swellings which burst and discharge their contents and are followed by scars. The Wassermann and urine tests were negative. A Von Pirquet test was mildly positive.

Serum taken from the face, grown on agar, showed the presence of staphylococcus albus, which were most likely absorbed from the nose or sinuses. A culture from the nose revealed the presence of a very free growth of the staphylococcus albus together with the short chain streptococcus non-hemolyticus. A vaccine was made and the injections were given, together with the tuberculin for the corneal condition.

DISCUSSION: Dr. WM. M. LESZYNSKY asked if there was a pathologic extravasation into the tissues of the face in this disease. Dr. Weidler stated that the pathology of the disease was not clearly understood; no lymphatic changes had been noted by any observer.

Dr. A. E. DAVIS asked about the Wassermann test and if a T. O. diagnostic test was made. Dr. Weidler had not done the T. O. diagnostic test. The Wassermann was negative.

A case of **melanosarcoma of the lower lid** was presented by Dr. H. H. TYSON. W. V. E., male, age 37 years, had noticed a thickening of the skin on the margin of the outer third of the right lower lid for a considerable time. About six months before, enlargement of the growth occurred, but pigmentation upon the edge and inner aspect of the palpebral conjunctiva was not noticed until about April 6, 1922. Diagnosis of melanosarcoma was made and he was referred to Dr. Fordyce for an opinion. Dr. Fordyce considered it clinically a pigmented epithelioma, although stating it to be potentially a melanosarcoma; and advised its removal by the high frequency spark and electrolytic needles. As with this method the liability of inducing metastases is diminished, it was used on April 19th, and a V-shaped portion of the lid sloughed off, which has been replaced by granulation tissue, leaving very slight disfigurement.

A case of **asteroid hyalitis with thrombosis of the central vein** of the retina was reported by Dr. A. S. TENNER. A man, aged 60 years. History of two attacks of "stroke" from which he had seemingly completely recovered. Two months before he became suddenly blind in the left eye. Vision of the right eye = $\frac{20}{200}$ improved to $\frac{20}{70}$; vision of the left eye = fingers at one foot. Fundus of the left eye presented an apoplectic retina. Disk margins were obscured by hemorrhage so that only the central half was visible. In the vitreous were innumerable bright spots, globular, oval, or pear-shaped.

Verhoeff had reported a case associated with retinal hemorrhage. Holloway had referred to a similar case. The association of this case with thrombosis of the central vein of the retina was of interest in this regard.

Dr. A. S. TENNER read the report of a case of **post-neuritic atrophy** of the optic nerve in a case of tabes, adding a few remarks on the differential pupilloscope in connection with this case.

DISCUSSION: Dr. M. J. SCHOENBERG stated that optic neuritis is rare in tabes, and first one must make certain the optic neuritis is not due to some other cause. Here we meet again the problem so difficult to solve,—how to make a diagnosis of a non-syphilitic process in a patient with syphilis.

Regarding the pupilloscope, it promises to be of great value for measuring pupillary reactions and for localization of pathologic lesions along the optic paths.

Three cases of **hypertension after cataract extraction relieved after removal of focus of infection** were presented by Dr. I. A. HINSDALE and Dr. BEN WITT KEY.

CASE I.—J. E. (#27817), male, aged 76 years, admitted to New York Eye and Ear Infirmary, July 27, 1921. Mature senile cataract, O. D. Vision: fingers at one foot. July 27th, preliminary iridectomy. Four weeks later uncomplicated extraction by Dr. C. Shannon (house-surgeon). Six days later violent cyclitic reaction,—intensive treatment—and discharged in one month. Readmitted one month later,—low-grade iritis, dense secondary membrane and hypertension. De Wecker by Dr. Key. Discharged in ten days, eye quiet. Readmitted in twenty-eight days with similar condition as above. Wassermann, X-ray, and other laboratory tests having

been negative, removal of teeth with infected roots followed by gradual but definite improvement and tension reduced to normal. December 9th, eye quiet, vision $\frac{1}{10}$ with correction.

CASE II.—F. W. (# 1700), male, aged 56 years, admitted to Infirmary November 4, 1921. Mature senile cataract, O. D. History: Three previous sinus operations. November 4th, preliminary iridectomy. Later extraction by Dr. Key without complication. Discharged due time, eye entirely quiet. January 21st readmitted with low-grade iritis and hypertension. Paracentesis performed without permanent effect. All tests having been negative, exenteration of the ethmoidal sinuses revealed polypi and pus. Almost immediate improvement in the ocular condition and tension in five days reduced to normal, and has remained so to date.

CASE III.—H. K. (# 36889), male, aged 57 years, admitted November 9, 1921. Sclerosed lens O. D. Vision: $\frac{20}{200}$. November 9th preliminary iridectomy. November 30th lens extracted by Dr. Hogan (house-surgeon) with uneventful recovery. Discharged in fourteen days, eye normal as after cataract. Six weeks later low-grade iritis with hypertension. Iridectomy by Dr. Key. Ten days later hypertension recurred. Removal of badly infected tonsils on January 30th, laboratory tests having been negative. February 4th, the eye quieting, tension normal, and vision $\frac{3}{8}$ with correction.

Dr. Ben Witt Key regarded these cases as important in this connection for the following reasons:

1st. Under most careful examination there was no evidence in any of these cases of iris encarceration or prolapse; no tag of capsule blocking the iris angle; no formidable opaque lens substance; no crowding forward of the iris, the anterior chamber in each case being normally deep after extraction.

2d. Low-grade iritis and cyclitis developed with hypertension secondary one month to six weeks after extraction in each case.

3d. Recovery from iritis with restoration to normal tension followed removal of a focus of infection, no other treatment being administered but hot bathing and atropine, other laboratory indications being negative.

These three cases occurring over a period of nine months in the hospital, strikingly similar—clinically and therapeutically

—seem to demonstrate the value of preventing as well as relieving that type of glaucoma secondary to low-grade iritis after extraction, in which perhaps the consistency and character of the contents of the anterior chamber is the mechanical cause, in turn due to a focus of infection of suitable location and virulence.

DISCUSSION: Dr. G. H. BELL stated that studying focal infections is the most important work that is being done in medicine to-day. Every patient should be given the "Acid Test for the Three T's." He emphasized the necessity of studying these cases before operation as well as when complications arise.

He referred to numerous cases of chronic simple glaucoma controlled by removal of foci of infection and regulation of the diet and the habits of life. He further insists upon a "Reform Diet" which consists of not mixing starches and proteids at the same meal, and in reducing the intake of sugars and sweets.

Dr. MARTIN COHEN presented a **Morton electric hand ophthalmoscope** with a green film filter attachment for red free light examination of the fundus.

REPORT OF THE TRANSACTIONS OF THE ANNUAL CONGRESS OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM.

By Mr. H. DICKINSON, London.

Industrial Diseases of the Eye.

At the recent Congress held by the Ophthalmological Society of the United Kingdom, an afternoon was set apart for the discussion of industrial diseases of the eye (excluding accidents, miners' nystagmus, and glass-blowers' cataract).

Dr. T. M. Legge, C.B.E. (H. M. Inspector of Factories), opened the discussion from the administrative side. He spoke first of intractable conjunctivitis caused by hydrogen sulphide. He saw, on one of his factory visits, a chemist with intractable conjunctivitis, especially marked in one eye. This man periodically applied the eye which was chiefly affected to a little peep-hole where a process of manufacture was going on, and in doing so he lifted up a little piece of glass in order to see better into the chamber, and it was the resultant stream through this aperture which kept up the inflammatory condition. He remembered, too, in the early days of the manufacture of sesqui-sulphide of phosphorus, that the life of a manager was made miserable by the small amount of hydrogen sulphide which was given off into the atmosphere when the sesqui-sulphide came into contact with moisture. This was not relieved until the whole process was carried on under a negative pressure. He spoke chiefly on the optic neuritis set up by lead-poisoning. He exhibited a carefully prepared chart showing the gradual decline of cases of this condition from the time when the instances numbered 1,200 in a year, to the present time, the fatal cases being shown in red. He separated the cases due to encephalopathy from those of optic

neuritis uncomplicated by such manifestations as lead convulsions. He had also indicated those who were suffering from mania or mental hebitude. In the white lead industry there had been a tremendous drop in the number of cases; there was also a large decrease in the paint and colour industry. But there was no corresponding diminution to record in industries in which white lead was used, as in coach-painting or shipbuilding. Cases occurring in house painting were not compulsorily notifiable, and up to 1914—the industries were abnormal during the war—there was a steady increase in the number of cases occurring. The diminution of the cases of optic neuritis due to lead in controlled industries was due to the fact that in them an exhaustive system of ventilation by means of fans to take away the dust produced was in operation, whereas the dust caused by sandpapering the dry paint in coach-painting could not be so carried away. The system of ventilation now in operation in the industries referred to did not depend on the workers' power of applying it or omitting to do so. Slides were shown illustrating the method in which this is carried out. A factory which, just before the war, was working for some country intensively on dinitro-benzine, had 28 cases of poisoning by that substance, including 4 of amblyopia. During the summer, owing to the volatility of the substance, a greater number of people were put on to the work in night relays, and these cases occurred in a burst. When the shift was reduced to four hours, the conditions improved. Dr. Holmes, of Wigan, said he had never seen cases with such extreme contraction of the fields of vision. During the war, T.N.T., which caused so much illness in the form of dermatitis and toxic jaundice, did not appear to have affected the optic nerve. Only two cases were brought to his notice, and in regard to these he had the reports of Dr. Patterson, of Edinburgh, who considered the weight of evidence favoured their being due to tobacco, rather than to T.N.T. In reference to tobacco amblyopia, his colleague, Dr. Middleton, followed up the case of a woman, a non-smoker who for 25 years had been employed in the leaf room of a tobacco factory. About nine months before being seen, her vision commenced to be defective. Mr. Sim, of the Edinburgh Royal Infirmary, investigated the case, and he reported that

it was a case of tobacco amblyopia. The woman had been exposed to finely-divided tobacco dust which was produced through a fine-meshed hand sieve.

Dr. Legge exhibited slides showing how, towards the end of the war, 12-inch shells were filled by means of movable flexible pipes, and the means used to carry away the fumes.

He also exhibited slides showing how anthrax affected the eyelids. Before the use of anti-anthrax serum the fatality of external anthrax—which was now normally 15 to 25%—was much worse when affecting the eyelid, especially the upper lid. At that time he considered that 40% to 45% of cases when the upper eyelid was affected would be fatal. Now, however, since the giving of the serum, in 80*cc* doses intravenously, followed by 60*cc* on the following day, the mortality of eyelid cases had been definitely reduced, so that the mortality in these cases was now much the same as in those where other parts of the body were involved. External anthrax seemed to be fatal in proportion to the degree of looseness of the cellular tissue at the site of infection; the eyelid was, of course, rich in such tissue. The slides shown were of different stages in eyelid infections.

Dr. Legge asked whether the increase in the long axis of the eyeball, constituting myopia could be regarded as an occupational disease. He commented on the comparatively little work which had been done on the subject of visual fatigue. Did the work, such as that of the compositor, cause myopia, or did that work merely cause special attention to be directed to a defect already there?

Mr. Bernard Cridland related his experiences in a large iron-workers' district, and exhibited a table of cases with particulars and histories.

Professor Collis discussed the relationship between visual acuity and vocational selection. Employers were rapidly coming to see the disadvantages resulting from a worker and his work being ill-mated; output was smaller when that was the case and discontent was generated by seeing his fellowman earn more than he could earn himself; it accounted for men drifting from place to place in search for a congenial employment. Behind the science of vocational selection lay the earlier science of vocational guidance, which should be in

the hands of teachers and juvenile advisory Committees, who, after ascertaining the capacity of each adolescent, should guide him in that walk of life wherein such capacity was needed and had scope. And no faculty had greater influence on capacity than that of vision, for as we saw, so did we react. Indeed, artistic appreciations must depend on visual acuity and the presence or absence of errors of refraction. Visual acuity was definitely related to industrial efficiency; the need for good vision in the engine driver and the seaman had long been recognized, therefore there was surely need for the vision of all motor-car drivers to be tested. Instances of the latter meeting with accidents were frequent, yet fining and endorsing the licenses seemed to sum up the resultant action, the men concerned being again let loose upon society. He knew of no case in which an offender had been referred to an ophthalmologist to have his sight tested. The Professor elaborated this theme by referring to personal experiences.

With regard to accidents, it had been concluded that 85% of all accidents were due not to absence of guards and safety appliances, but to such causes as negligence, carelessness, want of thought, and, most of all, to a lack of appreciation of danger. And Greenwood had pointed out, as a result of statistical enquiry, that there was a varying individual susceptibility to accident but no one had yet tried to connect such increased tendency with defective eyesight. Nevertheless, the relation between deficient illumination and accidents had been pointed out by Wilson and Patterson in this country, and by Simpson in the United States. The latter authority estimated that out of 91,000 accidents, 23.8% were due to imperfect illumination. Innate imperfect visual acuity might be an important factor in determining individual susceptibility to accident; certainly muscular contraction was less accurate and more liable to error where vision was imperfect. Visual acuity must also affect industrial efficiency. He was not aware that anyone had examined the best and the worst workers in different processes to ascertain their respective visual acuity; yet not until such had been carried out could anything valuable be known of the visual needs for different occupations. There was a great tendency to look after the rare and unusual diseases, which, after all, were but as a drop in the ocean.

With regard to the effect of industries upon visual acuity, certain occupations did produce certain of the eye diseases. Miners' nystagmus (which had been ruled out of this discussion) was associated at one end with very low illumination, and at the other end were cases of cataract caused by excessive exposure of the eyes to heat rays from molten metal. But what was less clear was the effect produced by less pronounced exposure in the ordinary circumstances of work. A necessary preliminary was to know the visual acuity possessed by the general community of the same age as these workers; he knew of no such information, but it was much needed. The closest approximation was that of juveniles of school age, but this could not be applied to adults, especially those of middle age, the age when the effect of occupation was most pronounced. It seemed clear that the human eye was never evolved for the purpose for which it was now so constantly used, and when so used it was found to be a more or less defective organ. How far this use acted injuriously required to be determined, so that acuity and occupation could be effectively mated. He pleaded for research upon the lines he had indicated, so that employers who needed people to work at various processes might know what standard of vision to look for in the people they might choose.

Mr. HEALY referred particularly to tin plate workers' cataract. In this industry he had seen a type apart from the posterior polar variety, and one found the posterior polar variety associated with the cortical variety in the lower cortex. Whatever the cause of the posterior polar variety might be, it was probably also the cause of the broom-like opacity in the lower and inner cortex. He did not think direct rays had much to do with it. He believed that heat rays were absorbed by the iris, and that owing to that continual absorption an alteration occurred in the secreting endothelium, and in that way the aqueous was altered; it might lead to the increased formation of salts in the aqueous, and there might occur spread along the ligament to the lens epithelium, thereby admitting aqueous by osmosis into the lens substance, leading further to swelling of lens fibres, and in that way to the production of cataract. The cortical variety might possibly be produced by some alteration in the essential lymph channel

which reached the posterior pole. He agreed with those who said there should be further investigation as to the effect of manual labor upon the general bodily health. He had in mind the case of a man aged 41, a roller-man in a mill, who consulted him because of homonymous hemianopia, which had come on suddenly. He retained central vision, but the condition never improved. No cause for that man's arterio-sclerosis could be found; his blood pressure was 205*mm*; his Wassermann, done several times, was negative, and several good physicians failed to find any cause for his arterio-sclerosis. Possibly men who were engaged in hot work such as this and were constantly sweating and imbibing large quantities of fluid, might develop arterio-sclerosis in consequence, and this might be an adjuvant factor in the production of cataract.

He had seen many cases of cataract amongst iron-workers and in them the results after operation were as good as in the general run of the population who had senile cataract.

Dr. BRINTON (of Johannesburg) said that occasionally posterior polar cataract was encountered in gold smelters and assayers, who had to be constantly assaying small samples in crucibles. It was not included in the diseases for which compensation was recognised, but he had got the manager of a large mine to recognise it as a subject for payment. He had never yet encountered a case of cataract from heat in the native possibly because the native had always been accustomed to considerable heat.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

A clinical meeting of the Section was held on Friday, 9th of June, under the chairmanship of Sir John H. Parsons, F.R.S.

Mr. J. F. Cunningham showed a patient who had a mass obscuring the optic disk. Even under the best conditions the mass could only be seen indefinitely; it involved the disk in its lower part. He thought it was possibly of congenital origin, though it might have followed upon some trauma.

Sir John Parsons thought it more likely that it was a congenital film, due to an excess of fibrous tissue on the disk, than that it was ordinary retinitis proliferans.

Mr. Doyne exhibited a case with symmetrical swellings of the lids. As the patient was an inmate of a mental hospital there might be doubt about the history he gave. There were symmetrical swellings towards the outer margin of the upper lid, in both eyes. The patient himself said they had been there ever since birth, and that they had undergone no appreciable change in size. At first he regarded it as a dermoid, but felt sceptical about that later because on pressure it gave a sensation of lobulation, such as from a lipoma. He asked for opinions.

Mr. J. B. Lawford thought cystic swellings could be excluded. Under pressure the tumors receded very readily, so that it was difficult to make out their outlines with the finger tips. And against the idea of dermoid was the fact of the swellings having been stationary in size for forty years; he believed orbital or extra-orbital dermoids were never station-

ary, some grew quite rapidly. In his view, the diagnosis lay between symmetrical fatty swellings and a soft form of congenital hydroma. Their extreme softness favoured the former view.

Mr. MALCOLM HEPBURN thought the possibility of it being lacrimal gland should be considered.

Sir JOHN PARSONS said the swellings apparently were similar to those frequently seen in the inner part of the upper lids in elderly people, and which were generally recognized as being due to orbital fat coming through the opening in the facial septum. He was unfamiliar with such swellings in the outer part of the upper lids.

Mr. OLIVER showed some beautifully executed models for *prothesis*.

Sir JOHN PARSONS said these models showed that the work had been brought to the pitch of a very fine art.

Mr. H. R. JEREMY exhibited a woman, aged 38, who had a *retinal detachment at the macula*. A fortnight ago she attended hospital and stated that she had been unable to see with the left eye for two years. When eight years of age, she was struck in that eye with a stone. At times the eye was painful. A fortnight ago she could perceive fingers at the periphery of the field, and now there was only perception of shadows there. The tension of the eye was not raised, there was no conjunctivitis, nor circumcorneal congestion, and the cornea was clear. There were, however, a few fine vitreous opacities. The disk was normal. There was a detachment of the retina at the macula, ovoid and regular in shape, grayish-white in color, and the surface was smooth. A fortnight ago the detachment was 4 or 5 disks in diameter, the edges were regular, and there was choroidal pigmentation below. The tension was raised plus 8 to plus 10. Wassermann reaction was negative. He had advised having the eye removed, but thought he would like opinions of members first.

Sir JOHN PARSONS said that if the detachment started in the macula it was a long history (two years). He referred to a case which was under the care of the late Mr. Marcus Gunn, in which a tiny tumor in the macular region manifested itself at an early stage in the history by a disturbance of the central vision. Examination showed, in the lower part of the fundus,

a large simple detachment of the retina, separated from a very shallow detachment just over the growth.

During the meeting, congratulations were offered to Sir Richard Cruise on the honour just conferred on him by his Majesty in creating him a Knight of the Royal Victorian Order.

NOTES.

OUT-PATIENT WORK IN OPHTHALMOLOGY.

PRELIMINARY REPORT OF ACTIVITIES OF SECTION ON OPHTHALMOLOGY OF THE ASSOCIATED OUT-PATIENT CLINICS OF NEW YORK CITY.

By Dr. CONRAD BERENS, Jr., Secretary of the Section.

The Associated Out-Patient Clinics of New York City, organized in 1912 as a federation of out-patient departments of the leading hospitals of the city, together with a number of dispensaries unattached to hospitals, recently resumed activities after an enforced lapse during the war. The dispensaries of the city have grown rapidly during recent years, it being estimated that 1,250,000 persons received dispensary care in New York City during 1921. Hence, the Associated Clinics feel an increasing responsibility to accomplish the purpose for which it was founded, the advancement of the standards and methods of out-patient work and the coördination of the many existing dispensaries and out-patient clinics of the city.

The work of the Associated Out-Patient Clinics is carried out largely through professional committees, representing the chief branches of medicine, surgery, and administration. These sections have developed in past years a body of standards for dispensary service, but the active interest and coöperation of the governing boards of the member institutions is essential in order to make this professional work of practical influence. For this reason, the newly adopted constitution of the Association provides that one of the two representatives of each member institution must be a member of the board of trustees or of the similar governing body. These representatives will

act as channels of communication with member institutions in endeavoring to make the Associated Out-Patient Clinics a coöperative organization for the improvement of dispensary services in New York City.

As many problems represented by out-patient work in ophthalmology were brought to the attention of the Association and it was deemed advisable to call a meeting of the ophthalmologists representing the member institutions of the Association and organize a section on ophthalmology for the purpose of considering these matters. Such a section was organized in January, 1922, at which time Walter E. Lambert, M.D., was elected chairman, Edgar S. Thomson, M.D., vice-chairman, and Conrad Berens, Jr., M.D., secretary. The Executive Committee were appointed as follows: Ellice M. Alger, M.D., Isaac Hartshorne, M.D., P. Chalmers Jameson, M.D., H. H. Tyson, M.D., J. M. Wheeler, M.D., Julius Wolff, M.D., and the officers.

At the several meetings of the Section, consideration was given to various topics, such as:

1. Lack of professional standards
2. Paucity of equipment
3. Overcrowding in all clinics, especially for refraction
4. Abuse of clinic by patients able to pay
5. Failure of patients to secure glasses when prescribed
6. Unsatisfactory financial arrangements with opticians
7. Lack of uniformity of fees charged for admission, drugs, laboratory examinations, glasses
8. Lack of provision for research
9. Incompleteness of records and inadequacy of filing system

The Section decided that no official pronouncement on these matters would carry weight unless sufficient facts were gathered upon which to base recommendations. The Executive Committee, therefore, outlined the research which was considered necessary and the following studies were made: Conrad Berens, Jr., M.D., assisted by Ray R. Losey, M.D., made a study of professional methods, equipment, records, teaching, and research in nine institutions (New York Eye and Ear, Brooklyn Eye and Ear, Knapp Memorial, St. Luke's, Post-Graduate, Vanderbilt Clinic, Manhattan Eye and Ear, Cornell Dispensary, and Health Department Clinic P.S. No. 30.) In-

formation was also secured as to the practice in these matters in representative clinics in other cities. A series of records was studied at each institution to ascertain their completeness from a scientific standpoint.

Studies of the admission procedure, fee systems, and the provision of glasses in four special eye clinics and eight eye clinics in general dispensaries were made by Gertrude E. Sturges, M.D., of the staff of the Associated Out-Patient Clinics.

In order to ascertain the need for systematic follow-up systems in eye clinics, a study was made of 5200 records from five representative clinics. The number and proportion of cases which might lead to blindness was determined and the care and disposition of these cases by the clinic was considered.

A summary of the findings of the studies together with the conclusions and recommendations arrived at by the Committee as a result of these findings will be presented in the report of the Section which will be available in the fall.